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SCIENCE, TECHNOLOGY AND PUBLIC POLICY

By Dr. LYMAN CHALKLEY

OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

FOR some years the world has been engaged in the most destructive war of history. This has been the most destructive war because it has been the most "scientific" war. The sciences have been mobilized, and, through their expressions in technology, have been applied to destruction. The devastating results have been of a magnitude and worldwide distribution utterly beyond the reach of even the most bloodthirsty militarists of former ages.

Thus, in destruction, as in its more constructive applications to medicine, industry and the comforts and conveniences of living, the scientific method has shown itself more efficient and more powerful than any other approach to the solution of practical problems which mankind has devised. In spite of this generally accepted fact, no adequate machinery for bringing our public policy into harmony with the development of science and technology has been set up.

There are many evidences of this situation. As early in the war as April, 1942, *Fortune* magazine pointed out that, although this was a scientific war, neither scientists nor technologists were members of the top military or civil policy-making groups. This is still true. The Dumbarton Oaks Plan, while recommending an Economic and Social Council, entirely ignored science and technology. The San Francisco United Nations Conference has done likewise. Yet no field of human activity is to-day a greater factor in the war-making potential of nations.

Another problem growing out of the war is the postwar control of Germany. In a letter of Sep-

tember 29, 1944, to the Foreign Economic Administration, President Roosevelt wrote:

Control of the War-Making Power of Germany. You have been making studies from the economic standpoint of what should be done after the surrender of Germany to control its power and capacity to make war in the future. This work must be accelerated, and under the guidance of the Department of State you should furnish assistance by making available specialists to work with the military authorities, the foreign service and such other American agencies and officials as participate with the United Nations in seeing to it that Germany does not become a menace again to succeeding generations.

On this subject numerous studies of various economic and industrial phases of the problem had already been made. The Brookings Institution had published a report on "The Control of Germany and Japan." Among other books on the same subject may be mentioned "The Problem of Germany," by the Royal Institute of International Affairs; "How to Treat the Germans," by Emil Ludwig; "How to End the German Menace, a Political Proposal by Five Hollanders," and "What to do with Germany," by T. H. Minshall.

Yet there seem to have been no studies of the scientific factors involved. The control of research is an idea foreign to our thinking; we have striven, and successfully, to encourage research. The direction of the output of the laboratories to socially desirable ends has never been a problem to us because we have looked upon science as a purely beneficient agency. Now the war has come along and taught us that science and technology can be the source of the most destructive forces the world has ever known.

Our thinking has not caught up with this appalling fact. There are no Brookings Institutions to study the relations of science and technology to our economic, political and social structures. The best that the Foreign Economic Administration could have done on the scientific phases of the assignment contained in the President's letter of September 29, 1944, would be to turn to a temporary wartime government scientific agency (since there are no permanent ones) for aid. It in turn could only enlist the advice of a group of competent men meeting as a committee in Washington or New York. The recommendations resulting from such a procedure are the best that could be obtained with our present machinery, but they are not the best that should be had.

However competent the advice and however well informed and wise the advisers, more than advice is needed for a new problem of this sort. The best of advisers are the first to base their advice upon a background of factual information as to conditions and relationships in the field in which they are advising. But adequate information cannot be gathered over night. Its accumulation generally requires a long period of painstaking study. In various economic fields we have a background of many factual studies, but in the field of what might be called "science policy" we have virtually none.

Yet the control of German science, so that it cannot become the physical basis for another war, is such an important matter to our nation, not only for the present moment but for a generation to come, that it is deserving of thorough and sustained study, for which there is no agency at the present time.

The problems of war are not the only ones in which science and technology are important factors in public policy. On November 17, 1944, President Roosevelt in a letter to Dr. Bush, the director of the Office of Scientific Research and Development, asked for advice upon:

First: What can be done, consistent with military security, and with the prior approval of the military authorities, to make known to the world as soon as possible the contributions which have been made during our war effort to scientific knowledge?

The diffusion of such knowledge should help us stimulate new enterprises, provide jobs for our returning servicemen and other workers, and make possible great strides for the improvement of the national well-being.

Second: With particular reference to the war of science against disease, what can be done now to organize a program for continuing in the future the work which has been done in medicine and related sciences?

The fact that the annual deaths in this country from one or two diseases alone are far in excess of the total number of lives lost by us in battle during this war should make us conscious of the duty we owe future generations.

Third: What can the Government do now and in the future to aid research activities by public and private organizations? The proper roles of public and of private research, and their interrelation, should be carefully considered.

Fourth: Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?

In turn Dr. Bush appointed very able and conscientious committees to consider these matters and to advise him on the recommendations he should make to the President. These committees had a background of information to draw upon. The National Resources Planning Board, and its predecessor, had already issued reports on "Industrial Research" and on the "Relation of the Federal Government to Research." There had also been hearings on the patent system by the Temporary National Economic Committee, and still later there were numerous hearings on the war use of science and technology before Sen-

[Sena]tor Kilgore's Subcommittee on War Mobilization of [th]e Senate Military Affairs Committee.

However, the peacetime questions raised by the [P]resident are not only important but continuing, [a]nd they may be expected to grow in importance in [t]he future. Certainly they cannot be answered at [o]ne time, once and for all, by ad hoc committees [w]hich go out of existence when their reports have [b]een written, or even by a temporary wartime gov[e]rnment agency whose life is also limited.

The perpetuation of the Office of Scientific Re[s]earch and Development after the war might seem [t]o meet the need for continuity in the study of the [r]elation of science to public policy. Certainly a per[m]anent government scientific agency is needed. How[e]ver, some matters in the relation of science to public [p]olicy are too broad and too important to the welfare [o]f the American people to be entrusted solely to [a]ny administrative agency.

For example, the scientific rearming of Germany [i]n preparation for the war was well known to American scientists and this information was avail[a]ble to the Federal Government. Yet the government took no action until after the fall of France to pre[p]are for its own scientific rearmament. The Army [a]nd Navy appropriations for research had been pared [t]o the bone, and this paring seems to have been [d]one by the Administration itself. For in a hearing [b]efore the Select Committee of the House on Post-War Military Policy, Representative Snyder stated [i]n speaking to Colonel Osborne, who was testifying [f]or the Army Service Forces:

> Since I have been chairman of one of the Appropriations Committees, which has been for 7 years, we have never turned down a single cent that has been asked by the Army for research and development. So, if they do not have enough money for research and development, it is not the fault of Congress or it is not the fault of my committee. It would be the fault of somebody downtown.
>
> I do not know whether it is the Bureau of the Budget or whether it would be the Army agencies that have looked after that. But it is not the fault of my committee or the fault of Congress as a whole, if you do not have money for research and development, because you got everything you asked for, or you have at least for the last 7 years.

Later in the same hearings Representative Mott in questioning Dr. Jewett, president of the National Academy of Sciences, said:

> In my recollection, the Congress has never refused to appropriate for research, and never refused to appropriate for an educational order, whenever they were asked, but the history of it is that the Services were not allowed to ask the Congress for the money. The Budget either eliminated it or cut it down, and these necessary research activities which we know were very necessary, never even came to the Congress. They had a rigid restriction under the present set-up as to what an agency of the Government, what the Army or the Navy might ask Congress for. If they put in an estimate to the Budget and the Budget said, "You don't need that," they were precluded by Executive Order from even saying anything about it to the Congress. That is one thing I think ought to be corrected.

Clearly there was no agency concerned with scientific policy in these crucial years before the war to study, and to make generally known, Germany's scientific preparation for war, and the organization of our own government for scientific preparedness. The lack of adequate scientific representation and advice in the councils of the Army, the Navy and the Bureau of the Budget in the critical years before the war, if such were indeed the case, could have been disclosed only by a non-governmental source. Even the National Academy of Sciences could hardly have made such a report because of its quasi-governmental position.

The scientific preparedness of the country after the present war is of paramount importance to our future welfare. This point was stressed by the director of the Office of Scientific Research and Development who, in his testimony before the House Select Committee on Post-War Military Policy, said:

> The great change in pace which science and technology have introduced into warfare underlines the vital importance of continuing an effective research on military problems in time of peace. In the past, the pace of war has been sufficiently slow so that this nation has never had to pay the full price of defeat for its lack of preparedness. Twice we have just gotten by because we were given time to prepare while others fought. This time the margin was narrower than in 1914. The next time—and we must keep that eventuality in mind—we are not likely to be so fortunate.
>
> The speed and surprise with which great damage could be done to our fleet at Pearl Harbor is only a mild warning of what might happen in the future. The new German bombs and rocket bombs, our own B-29, and the many electronic devices now in use which were unknown 5 years ago, are merely the forerunners of weapons which might possess overwhelming power, the ability to strike suddenly, without warning, and without any adequate means of protection or retaliation. I do not mean that some methods of protection or retaliation could not be developed. I only mean that we might not be given sufficient time within which to develop these means, once hostilities had begun, before disaster overtook us.

The public should be kept informed on the progress and state of this preparedness, not just now, when there is little danger of another world war, but for years in the future.

The continuing study of the proper place of science and technology in our national life and in the world

is a project similar to those which are undertaken by the Brookings Institution, the National Industrial Conference Board, the 20th Century Fund, the Russell Sage Foundation, the Foreign Policy Association and other organizations in various fields of social and political economy. While there are foundations devoted to such thoroughly worthy objects as the promotion of good government in Philadelphia and the promotion of Henry George's writings and ideas, there is none devoted to the equally worthy studies which may be necessary to keep us from being exterminated by bombs or germs sent us from abroad, or to help us to avoid exterminating ourselves through the misuse of powers whose effects we do not yet fully understand.

It might seem that the study of the economic and social relationships of science and technology could be undertaken as a project of one of the economic research organizations or of the scientific research organizations, such as the Carnegie Institution, The Franklin Institute or the California Institute of Technology.

There is probably no basic reason why either the economic or physical science institutions should not undertake such studies. But there is the important empirical fact that a gap exists between the econo mists and the natural scientists in methods of think ing, approach to problems and in their contacts wi each other. It might require very considerab changes in the existing research organizations t equip any one of them for studies of the place o science in our economy.

However, the gap between the natural and soci scientists is narrowing. Even well before the w the Massachusetts Institute of Technology include in its curriculum studies of economics, managemen and industrial relationships along with the techno logical courses. During the war Dr. Bush and hi Office of Scientific Research and Development hav made great strides in bringing scientific viewpoin into the war councils not only of the military but o the civilian agencies of the government as well.

The time may be approaching when a rational an sustained attack upon the problems which science an technology have introduced into the life of the natio and of the world will not only be possible but ma even seem sufficiently interesting and imposing t stimulate a major study of these things. Let u hope so, for our future security and welfare ma depend upon it.

SURFACES OF SOLIDS IN SCIENCE AND INDUSTRY. II

By Professor WILLIAM DRAPER HARKINS
UNIVERSITY OF CHICAGO AND UNIVERSAL OIL PRODUCTS COMPANY

(*Continued from page 268*)

III. The Area Occupied by Molecules

It is now possible to calculate the area occupied by a molecule. It has been customary to measure the area (Σ) of a solid by assuming an area (σ) for the molecule and multiplying this by the number (N) of molecules in a complete monolayer. Since our new method makes it possible to obtain the area of a solid without assuming a molecular area, and the BET theory makes it possible to calculate N, the area per molecule is given by

$$\sigma = \Sigma/N$$

The extremely interesting plot (Fig. 10) results when the number (N) of solids, on which the nitrogen molecule exhibits a certain area, is plotted on the y-axis and the molecular area (σ) on the x-axis. The minimum molecular area found on 119 solids is 13.45 square A and the maximum, 17.05 square A, with peaks at 14.05, 15.25 and 16.25. Thus, the areas of nitrogen molecules vary from about that calculated from the volume relations of solid nitrogen to that obtained from liquid nitrogen.

That these areas correspond to real effects is indicated by the following interesting facts:

1. The nitrogen area on a catalyst may have *an of the above values,* but this shifts to 16.2 square A

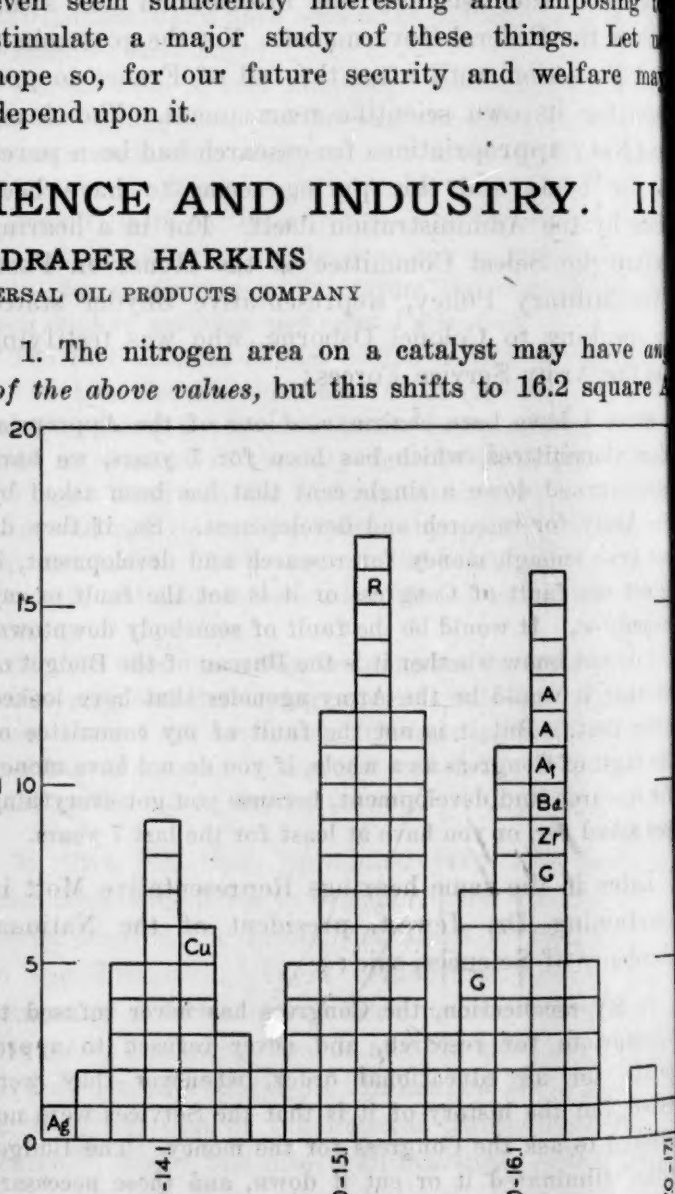

FIG. 10. Areas occupied by nitrogen molecules in complete monolayers on various solids.

after use with hydrocarbons, which results in the deposition of a solid containing both carbon and hydrogen. However, when the carbon is burned off, the *nitrogen area returns to its initial area.*

2. A silica-alumina catalyst gives a nitrogen area of 15.2 square A., if less than 8 per cent. alumina is present, but above 8 per cent, it shifts to a lower value of 14.0 square A.

3. An alumina catalyst gives an area of 15.2 square A with less than 10 per cent. of a second component, but 16.2 square A at 10 per cent. or above.

4. Heating a catalyst for a period of 8 or 10 hours may reduce its area from 400 to 200 square meters per gram without a change of the nitrogen area, but use, with heating, for a long period gives a nitrogen area of 16.2.

The molecular areas for hydrocarbons also vary with the nature of the solid: for butane (4C) the values for a small number of solids are 56.6 for crystalline and from 37 to 52 for porous solids, and for heptane (7C) from 58 to 66. In the monolayer these molecules lie flat in the surface, but in general occupy considerably more area in the complete monolayer than corresponds to the cross-section of the molecule in this position.

Catalysts. One of the more important uses of the surfaces of solids is in catalysis. Many types of more or less porous solids are employed, and the number of chemical materials produced is so large that it is not possible to list them here. They include products from petroleum such as high octane gasoline, toluene for TNT, butadiene and styrene for rubber; from the atmosphere such products as ammonia for fertilizers and explosives; food products and soaps modified by hydrogenation, etc.

In general, the rate at which catalysts act depends upon their area and the sizes and size distribution of their pores. Cracking catalysts exhibit areas as high as 70 acres per pound with pores of the order of 10 billion miles in length. Charcoals of certain types have even higher areas, which is related to their high porosity, but carbon black, which is nonporous, may have areas as high as 80 acres per pound, owing to the fact that the spherical particles have extremely small diameters.

IV. The Surfaces of Liquids

Measurements of the surface energy of liquids are much more simple than those of solids, and in the past investigators have not made sufficient use of the surface relations of liquids in their work with solids. At 25° C the surface tension of water is 72 dynes per centimeter, so the work used in expanding the surface of a body of water by 1 square centimeter is 72 ergs (which is the free surface energy of water), while the corresponding value for normal hexane, a hydrocarbon with 6 carbon atoms per molecule, is only 18 ergs. The high value for water is due to the polar character of its molecules, because of which it acts as though it contains positive and negative electrical charges slightly separated from each other. If the hydrogen of water is replaced by a methyl group the free surface energy is only 22 ergs, not much above that of a hydrocarbon and very much below (less than a third) that of water. The explanation of this is that in the surface the molecules of alcohol orient themselves in such a way that the hydrocarbon (methyl) groups are oriented into the surface, so the surface is nearly that of a hydrocarbon.

The theory that molecules are oriented in surfaces and interfaces has had a profound effect upon the development of surface chemistry, of colloid science and upon theories of the internal structure of liquids, particularly on the structure of soap solutions, and is of fundamental importance in biology.

With oil films on water the theory is very simple. Hydrocarbon molecules lie flat on water in a layer one molecule thick (monolayer), and this is true of alcohol molecules if sufficient area is available. However, if the alcohol film is compressed by the use of barriers, the molecules stand up like soldiers on parade. Since the polar or oxygen-containing end of the molecule is highly attracted by the water, while the nonpolar hydrocarbon and is attracted very much less, the polar groups orient themselves toward the water, while the hydrocarbon groups orient themselves toward the gaseous phase, or toward an adjacent oil phase, as at a water-hexane interface. For those who are interested in the technical aspects of the problem it may be said that "hydrogen bonds" are formed between the polar groups and the water molecules.

Oil films on water may be polymolecular in thickness (even 1 or 2 mm in thickness), but such a film is unstable and changes finally into a monolayer and lenses of oil.

V. Polar and Non-Polar Solids and Molecular Attraction

Solids may be classified as:

1. Polar solids, with a strong attraction for water and for polar groups. These include quartz, glass, titanium dioxide, barium oxide, etc.

2. Nonpolar solids, with a small attraction for water—paraffin, graphite, carbon black, antimony trisulfide, etc.

Fig. 11 exhibits two types of molecular orientation on the surfaces of solids. The energy required to pull (energy of adhesion) water away from either

of the polar solids, titanium dioxide (anatase) or quartz, is about 680 ergs, if an area of 1 square centimeter is considered, while the corresponding figure for the hydrocarbon, iso-octane, is only 155 ergs, or less than a fourth as much. The above indicated

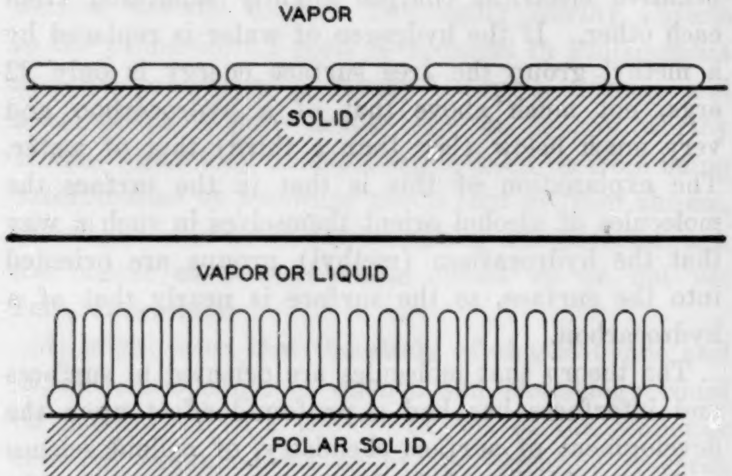

FIG. 11. Orientation of molecules in complete monolayers on the surface of a solid: *above*, hydrocarbon molecules; *below*, molecules of the type of those of an alcohol, an organic acid, a soap, etc., on the surface of a polar solid.

values give the total amount of energy necessary to pull the liquid from the surface of the solid. The work required (work of adhesion, w_A) is much less, and in the same units is 340 for water and 90 for the hydrocarbon (normal heptane was used).

With a change to a relatively nonpolar solid, graphite, these values are modified: downward with water, upward with a hydrocarbon. With water the energy of adhesion is decreased from the 680 for the two polar solids to 295, while with heptane it is increased from 155 to 245. The work of adhesion is reduced from 340 to 96, while with heptane it is increased from 90 to 109.

Laminated glass. As an illustration of the use of polar groups in industry the manufacture of laminated glass may be cited. In 1929 this was a sandwich which consisted of a sheet of transparent nitrocellulose known as celluloid 0.020 inch thick between two sheets of ⅛ inch glass. Unfortunately, celluloid in the presence of sunlight, especially when water is present, is unstable and liberates oxides of nitrogen which give a yellow, brown or even red color to the lamination and causes the glass to fall apart. The celluloid was made to adhere to the glass by the use of an adhesive which consisted of gelatine dissolved in water or in glycol.

The writer suggested that cellulose acetate, which is much more stable to light than celluloid is, should be substituted for it, but it was known that ordinary adhesives did not give a good "bond" between the glass and the plastic. At that time the energy relations between organic molecules and polar solids, as given in the preceding section, were unknown, but the writer knew that glass surfaces act much like those of water, though with a much higher surface energy, and so suggested that cellulose acetate could be made to adhere well to glass by introducing into it the proper polar groups to increase the adhesion. If introduced into the whole sheet, these would change the properties of the cellulose acetate in an undesirable way. However, by making an adhesive from cellulose acetate which had been treated to give the proper polar groups, an adhesive was produced which gave an excellent bond.

Between 1932 and 1940 over two-thirds of the laminated glass used in the United States was made in this way. This illustrates the value of a scientific principle in industry, since those who employed empirical research methods were not able for years to make a really good bond between this plastic and the glass. In conclusion, it may be stated that the plastic used at present contains enough polar groups of the right kind to make a good laminated glass without the use of an adhesive.

VI. THE DISTANCE TO WHICH THE ATTRACTIVE ENERGY OF A SOLID EXTENDS INTO A LIQUID OR A FILM

One of the fundamental previously unsolved problems of physics is the distance to which molecular attraction extends. A related problem is the thickness of adsorbed films. According to one school of thought, these are never more than one molecule thick, while another believes them to attain a polymolecular thickness. This problem has been settled both by weighing the films and by determining the number of molecules adsorbed per square centimeter.

Of the 16,450 calories of energy necessary to desorb one mole of water (6.06×10^{23} molecules) from the first molecular layer on the surface of anatase (quartz and similar solids exhibit almost the same value) 9,900 (E_L) would have been used if the molecules had been separated from water, so the excess is 6,550 calories. For the second layer this excess is 1,380 and for the third 220 calories. While the effect of

TABLE 1

MOLAR ENERGY OF DESORPTION OF MOLECULAR LAYERS OF WATER FROM THE SURFACE OF TITANIUM DIOXIDE (ANATASE) MINUS THE ENERGY OF VAPORIZATION OF WATER ($E_n - E_L$) (Calories per mole)

Layer	Heat of Desorption	$E_n - E_L$
1	16,450	6,550
2	11,280	1,380
3	10,120	220
4	9,971	71
5	9,951	51
6	9,932	32

the attraction of the solid dies off rapidly, it extends to somewhat more than 5 molecular layers.

Table 1 indicates that it requires 6,550 calories more to vaporize a mole of water from the first monolayer of water on the surface of anatase than from water itself. For the second layer the excess is 1,380 calories and for the third, 220 calories, and none of these is negligible.

A nitrogen film attains a thickness at $-195.6°$ C. of 10 molecular layers, or 36 A, butane 64 A, and heptane from 50 to over 100 A, depending upon the subphase.

Thus, experiment decides in favor of the polymolecular nature of adsorbed films, and, contrary to the views of a certain group of scientists, in a film or liquid on a solid the attractive interaction extends much farther than to the adjacent molecules. However, it does not agree with the views of those who believe the film to be very thick.

VII. Phases and Phase Changes in Adsorbed Films on Solids

Five phases have been discovered in films on solids. These seem to be: (1) gas, (2) expanded, (3) intermediate, (4) condensed, (5) second condensed. These designations are those used for films on liquids.

Solid films on water melt without the adsorption of heat. Thus, there is no latent heat of fusion. Such changes are considered to be of the second order, and phase changes of the second order are much more common in films on either solids and water than first order changes, which exhibit a latent heat. Certain oil films on water which are in the liquid state vaporize without the absorption of any heat (second order), while others involve a heat of vaporization (first order). In three dimensions isothermal vaporization is always accompanied by the absorption of heat, and, contrary to the opinion of experts on adsorption that such first order changes do not occur in films on solids, we have recently discovered such changes, both on metals and non-metals.

On account of the great importance of surface films on solids in both industry and agriculture, the subject discussed in this lecture should advance rapidly, since some of the fundamental relations have now been developed.

OBITUARY

GEORGE ARGALE HARROP, JR.

Eheu fugaces, Postume, Postume

The years slip away and our friends are lost to us, but they will live forever in our hearts and memories. Born in Peru, Illinois, in 1890, George Argale Harrop enjoyed a world-wide reputation as a scientific investigator, particularly in metabolism and nutrition. In such work lay his greatest delight and happiness, and the achievements in the brief span allotted to him were so great that little need be said here.

He had a very large circle of friends and acquaintances throughout the scientific world. This was due not only to his repute but also to the extent of his wanderjahra. Following two years in the University of Wisconsin he went to Harvard and received an A.B. in 1912. Going thence to the Johns Hopkins University to study medicine, he obtained his M.D. in 1916 and became in succession interne, resident and instructor in medicine. One of the happiest years of his life followed when he went to Europe and studied in Copenhagen under Professor Krogh. His admiration for his teacher was very great, and he was delighted when Professor Krogh came to the United States in 1938 to take part in the dedication of the Squibb Institute. On his return to this country, he spent two years at Columbia University and then went to China as associate professor of medicine in the Peking Union Medical College.

While in China, in 1924, he married Esther Caldwell. To one who knew Dr. Harrop in later life there was no more outstanding characteristic than his deep affection for his wife and for the four children—three boys and a girl.

Returning to the United States in 1924, Dr. Harrop was appointed associate professor of medicine at Johns Hopkins. Here he carried on his studies on nutrition and metabolism and took a leading part in the work of the department of medicine, where one of his greatest pleasures was his contacts with the internes and students.

He made two trips to South America. One of these in 1921–22 was a purely scientific expedition with the Royal Society to Peru and the high Andes, and the other was in 1939 when he paid a visit to all the medical centers in Mexico and South America. These trips added to the evergrowing circle of scientific friends. They left him with a deep interest in the countries he had visited and he would frequently recall, with enthusiasm, his experiences.

During his eight years in New Brunswick many of his old friends—from Europe, from Asia, from Mexico, from South America and from the United States—visited him there or at his home in Princeton to his delight. Old friendships were renewed, old scientific discussions reopened and the new work and surroundings critically examined.

After the founding of the Squibb Institute for

Medical Research in 1937, although he endeavored to continue his own studies through the Division of Internal Medicine, it soon became apparent that this was not possible. It is perhaps one fault of modern life that scientists so often are rewarded by administrative positions rather than by the removal of whatever fetters may prevent fuller accomplishment. But in this case what science lost on the one hand it gained on the other and to his colleagues and assistants the gain was immeasurable. His time and quiet kindly counsel were always available and the accomplishments of the Squibb Institute in chemistry, in chemotherapy, in microbiology and in pioneer work on penicillin in the United States are a part measure of his scientific wisdom and human encouragement.

The Squibb Institute represented for the late Theodore Weicker, chairman of the Squibb Board, the dream of a lifetime. Through the untiring efforts of Dr. Harrop this dream was realized. The successful demonstration that fundamental research can proceed within an industrial pharmaceutical organization will be a memorial to his vision and energy, and he would have wished none better.

Dr. Harrop belonged to the following societies: The American Scandinavian Foundation, the American Medical Association, the Association of American Physicians, the American College of Physicians, the Society for Clinical Investigation, the American Society of Biological Chemists, the Society for Experimental Biology and Medicine, the Société Biologique of Paris, Cosmopolitan Clinical Clubs, the New York Academy of Medicine, the American Clinical and Climatological Association, Phi Beta Kappa Society, Alpha Omega Alpha, Phi Kappa Psi, Nu Sigma Nu and Sigma Xi.

Dr. Harrop was shy on first acquaintance but, when one knew him well, showed that none could be a truer friend or more congenial companion. He would amaze one by the warmth of his sudden boyish enthusiasm. Those who knew him in relaxed and philosophical mood can testify to the pleasant conversations which would last late into the evenings. He was above all a kindly man. Perhaps one of the greatest of his trials as an administrator lay in those situations in which a reprimand of greater or lesser degree was necessary. The reprimand would be given in gentle and apologetic terms, and it was often the director who was most embarrassed while the culprit sat unhappily wondering how to shorten the painful episode for his inquisitor.

He died on August 4, 1945, after an ordeal of many months. Those who knew him best realized that his health had worried him for several years and that he had seen what lay in store. But, because of his intense desire for an early ending of the war and his scientific urge, he drove himself until the last illness slowed his body but not his mind. He died for his country as truly as any soldier, and his loss is a grievous one to all who loved him.

GEOFFREY W. RAKE
JOHN F. ANDERSON

NEW BRUNSWICK, N. J.

RECENT DEATHS

DR. FRANCIS B. SUMNER, professor of biology emeritus of the Scripps Institution of Oceanography of the University of California, died at La Jolla, Calif., on September 6 at the age of seventy-one years.

DR. CLEMENT R. JONES, of the School of Dentistry of the University of Pittsburgh, died on September 3 at the age of seventy-four years.

DR. I. PAUL MAIZLISH, professor of physics at the Eastern Kentucky State Teachers College, died on September 4 at the age of forty-seven years.

DR. JAMES THOMAS WILSON, emeritus professor of anatomy of the University of Cambridge, died recently at the age of eighty-four years.

ROBERT BRINTON HARPER, formerly vice-president of research and testing of the Peoples Gas Light and Coke Company, Chicago, a fellow of the American Association for the Advancement of Science, died on August 29. He was born on February 28, 1882. Among the many distinctions awarded him were the Beal Gold Medal of the American Gas Association, 1931; the Walton Clark Gold Medal of the Franklin Institute, Philadelphia, 1938, and the Annual Citation of the American Institute of Chemists, October 6, 1944. He was chairman of the Blackout Committee in the Organization of Techniques, Office of Civilian Defense for the Metropolitan District of Chicago.

SCIENTIFIC EVENTS

THE MEXICAN MATHEMATICAL SOCIETY

THE annual meeting of the Mexican Mathematical Society was held this year during the week of May 28th at Guadalajara. Five American mathematicians were in attendance: Nelson Dunford, S. Lefschetz, F. D. Murnaghan, Rufus Oldenburger and Norbert Wiener. There were sections devoted to both pure and applied mathematics with many papers presented in each, among them one from each of the American visitors.

The first evening of the congress was devoted to a memorial to the late G. D. Birkhoff, a great friend

of Mexican mathematicians, with addresses presented by Professors Graef, Lefschetz and Wiener.

The generosity and gracious hospitality of the Mexican Mathematical Society and of the Governor of the State of Jalisco, of which Guadalajara is the capital, could not have been exceeded. In the middle of the week there was an excursion to the beautiful Lake Chapala, an hour's ride by automobile from the meeting place, and a very attractive dinner was served in connection with the excursion. There was, also, ample opportunity to see the artistic monuments and the like for which Guadalajara is famous. It will be remembered that the city is the location of some of the best murals of Orozco, and these were greatly admired by the members of the congress. The meeting terminated with a general banquet, and all these occasions provided many opportunities for close contact between the members and guests.

The meeting was a success in every way and the attendance was considerable, mathematicians and other scientists coming from all parts of the Republic. The fame of these meetings is spreading and there is no doubt that they are making a noteworthy contribution to the development of mathematics in Mexico and to the good relations between Mexican scientists and those of the United States. —S. L.

THE PROFESSIONAL TRAINING OF REGULAR ARMY MEDICAL CORPS OFFICERS

During the period of the emergency it has been necessary to place the bulk of Regular Army Medical Corps officers in administrative positions in the Major Commands of the Army. This necessary procedure has caused a shortage of adequately, professionally trained Regular Army Medical Corps officers to take up the care of the Army sick and wounded, upon the release of AUS officers to civilian life.

In order that the Medical Department may be prepared to continue the excellent professional care of the sick and wounded in Army hospitals, the Surgeon General has requested the chief of staff to authorize courses in professional training for Regular Army Medical Corps officers. This request has been approved and a plan of training officers relieved from administrative or other assignments where professional experience was not available has been developed and placed in operation. This plan calls for the assignment of Regular Army Medical Corps officers to installations where courses in professional training, eventually leading to board certification, is to be carried out. The plan calls for training, not only in military medical installations, but in outstanding civilian installations. Representatives of all major forces concerned have contributed to this plan and officers assigned to any of these forces are eligible for the professional training.

The plan has been put into immediate operation in order that fully qualified Regular Army Medical Corps officers may be available to replace the presently highly qualified AUS officers, who are to be released in the present demobilization program, and who are at present holding the top professional positions in Army hospitals.

The Surgeon General is insistent that the outstanding record of care of the sick and wounded in this war be maintained, and for this reason, the far-reaching plan which he has prepared places foremost the professional qualifications and continued professional training of the Medical Corps officers. It is the sincere hope of the Surgeon General that all Medical Corps officers of the Army of the United States give earnest consideration to a career in the Regular Army, and he feels that with the development of his present plan, outstanding opportunity for professional advancement will be afforded to all Medical Corps officers.

APPOINTMENTS TO THE ILLINOIS STATE GEOLOGICAL SURVEY

The Board of Natural Resources and Conservation of the State of Illinois, upon the recommendation of Dr. M. M. Leighton, chief of the State Geological Survey, has recently made the following promotions and appointments:

Dr. Ralph E. Grim, petrographer and head of the Division of Petrography, has been made petrographer and principal geologist in charge of the Geological Resources Section. He will have general direction of the work done in that section, which comprises the following divisions: Coal, Oil and Gas, Industrial Minerals, Clay Resources and Clay Mineral Technology, Groundwater Geology and Geophysical Exploration, Areal and Engineering Geology, Stratigraphy and Paleontology, and Subsurface Geology.

Dr. Carl A. Bays, geologist and engineer, has been promoted to the position of head of the Division of Groundwater Geology and Geophysical Exploration. This division was recently established and is an outgrowth of the Division of Subsurface Geology.

Dr. C. L. Cooper, associate geologist, has been promoted to the post of geologist in the Division of Stratigraphy and Paleontology.

The following promotions and appointments were made in the Geochemical Section of the Survey:

Dr. G. Robert Yohe, chemist, becomes chemist and head of the Coal Division. Dr. Yohe and Dr. Orin W. Rees, chemist and head of the Analytical Division, are assistant chief chemists in interim during the absence of Dr. Frank H. Reed, chief chemist, now in Europe.

Dr. Glenn C. Finger, chemist, has been appointed chemist and head of the Fluorspar Division, and Oren

F. Williams, research assistant, has been promoted to assistant chemist.

Dr. William F. Bradley, chemist, has been made chemist and head of the Division of X-ray and Spectrography.

A Division of Chemical Engineering has been established, and Harold W. Jackman, chemical engineer, has been made chemical engineer and head. Donald M. Fort has been appointed assistant chemist and assigned as one of six members of this division.

Mrs. Regina M. Lewis, recently research analyst in the library of the U. S. Geological Survey, Washington, D. C., has assumed the position of geological librarian of the survey.

The Board of Natural Resources and Conservation comprises the Honorable Frank G. Thompson, director of the State Department of Registration and Education and chairman *ex-officio;* Dr. Arthur C. Willard, president of the University of Illinois, member *ex-officio;* Professor Norman L. Bowen, University of Chicago, representing the field of geology; Professor Roger Adams, University of Illinois, chemistry; Louis R. Howson, of Alvord, Burdick and Howson, Chicago, engineering; Professor E. J. Kraus, University of Chicago, forestry, and secretary of the board; and a member to be appointed as successor to the late Professor William Trelease, of the University of Illinois, representing the field of biology.

NEWS FROM ABROAD

PROFESSOR MARSTON TAYLOR BOGERT, of Columbia University, has received a letter from Professor Jaroslav Heyrovsky, of the Physico-chemical Institute, Charles University, Prague.

After the years of anxiety, we are well, though somewhat underfed. Some of my colleagues died unfortunately under most deplorable conditions in German concentration camps; of those you know Professor Antonin Simek, physical chemist of the Masaryk University in Brno, has been executed. I was, fortunately, able to work all the time in my laboratory and to do purely scientific work in my branch—polarography.

I am eager to know the development of physical chemistry in your country and also to tell something of the advances we did here to those of my American colleagues who work in my line. I am therefore looking forward to an opportunity of using a visiting professorship or a lecture trip, which would enable me to stay a semester or two in U. S. A. May I ask for your advice or friendly support to this aim? The wonderful experience I gained in your country as Carnegie visiting professor in 1933—thanks to your very kind offer—is a steady spur in my scientific endeavors and source of unforgettable joy.

Dr. Bogert has also received from Dr. Frank Kreysa, Stankov, the following wire:

Your brave armies, your insuperable science have vanquished as we anticipated the last enemy of mankind even as the world was expecting it. We felicitate you and your whole great nation and hail this famous victory. We thank you as well for the liberation of our children in USA. Special thanks to you for fatherly protection of our son.

Dr. Gustav Egloff, of the Universal Oil Products Company, has received the following letter from Professor Dr. Ir. H. I. Waterman, of the University of Delft:

I safely returned from German imprisonment and shall be starting work at the Delft University again. Till 1943 I could continue my ordinary scientific work. We did some work on magneto optic rotatory power of pure organic substances and their mixtures. I did this work in collaboration with the late Professor Wiessman, one of my colleagues.

I should be glad to come over to U. S. A. for some time, but I believe it is difficult to get a permit. Perhaps you know that I was invited to be a guest professor for two years at the University of Minnesota. The Germans, however, did not allow me to leave the country in 1943 and later I was taken prisoner and stayed in different camps.

I am anxious to hear what kind of scientific work was done in U. S. A. In 1940 I received the last bulletins.

I hope to hear from you in due course and I remain with best wishes also from Mrs. Waterman.

Mrs. Margaret M. Nice, of 5725 Harper Avenue, Chicago 37, Ill., writes:

A letter dated June 23, 1945, from Dr. N. Tinbergen, ornithologist and animal psychologist at the University of Leiden, gives news of himself and colleagues. In 1942 sixty professors resigned in protest against the "nazification" of the university; twenty of them were imprisoned as hostages along with thirteen hundred other patriots and internationalists. C. J. Van der Klaauw and Jan Verwey were released in 1943, Tinbergen not until 1944. Other biologists who survived are H. N. Kluijver, G. C. A. Junge, Boschma an De Beaufort, L. Tinbergen, G. V. Van Oordt, Baerends, Kortlandt, "A. F. J. Portielje and Bierens de Haan, though both nearly starved to death." "My students are gradually returning. Several of them are still in Germany where they were kept as slaves. At least three have died; one was captured and executed as a member of the underground forces." Despite conditions, considerable research has been accomplished.

Professor H. W. Shimer, of the Massachusetts Institute of Technology, writes:

It may possibly be of interest to your readers that the following wire was received by Mrs. Grabau (Mary Antin) from the Provost Marshall General of Washington, "Am pleased to inform you that Dr. Amadeus W. Grabau was contacted 21 August 1945 by Emergency Liaison Team from China in Pekin area."

Dr. William Randolph Taylor writes:

A card has been received from Dr. Johs. Boye Petersen, a well-known student of the fresh-water algae, stating

that all the botanists in Denmark are safe, and that the Botanical Museum and its collections at Copenhagen are intact.

Dr. H. A. Gleason, of the New York Botanical Garden, writes:

The many American friends of Professor Karel Domin, of Praha, Czechoslovakia, will be pleased to learn that he, his wife and his son are alive. During the war he has continued his botanical work at his home, apparently under much difficulty.

SCIENTIFIC NOTES AND NEWS

DR. DONALD BABCOCK KEYES, director of the Office of Production, Research and Development of the War Production Board and head of the Division of Chemical Engineering of the University of Illinois, has been awarded the Honor Scroll of the American Institute of Chemists, made annually to "a man adjudged to have made outstanding contributions to the world in chemistry or chemical engineering" in recognition of "distinguished achievements in chemical engineering practice, in teaching and in wartime service to the Government."

THE Yugoslav "Medal for Services to the People" has been awarded to Brigadier General Leon Fox, field director of the U. S. Typhus Commission, and to three other members of his staff.

THE Yale Medical Library has now on display a special exhibit arranged in recognition of the distinguished services of Dr. Charles-Edward Amory Winslow, senior member of the faculty of the Yale School of Medicine, who retired at the end of June. Since Dr. Winslow has for many years conducted seminars on the history of personal hygiene and the public health movement, the first part of the exhibit is devoted to early writings on hygiene beginning with Galen and his concept of the "Non-Naturals" in relation of health. Five display cases are devoted to Professor Winslow's writings. His contributions to the historical biographical phases of the public health movement occupy a separate display case. His latest monograph, entitled "The Conquest of Epidemic Disease," and a selection of his many monographs and papers on ventilation and air conditioning are displayed. The first volumes of the *Journal of Bacteriology* and the *American Journal of Public Health*, of which Dr. Winslow has been editor, the first since its inception in 1916 and the other since April, 1944, are also on view.

DR. HENRY E. BARRETT, professor of psychology at Columbia University, has been elected president of the American Psychological Association for 1946. The association has been reorganized to include several independent societies with a view toward a better representation of the interests of American psychologists.

PROFESSOR S. A. MITCHELL has been retired as director of the Leander McCormick Observatory after thirty-two years' service. In order that he may continue his research work at the observatory, the Board of Visitors has appointed him director emeritus. He will be succeeded as professor of astronomy and director of the observatory by Dr. Harold L. Alden, who for the past twenty years has been in charge of the Yale University Observatory at Johannesburg, South Africa. Dr. Alexander N. Vyssotsky has been promoted to a professorship of astronomy.

CLYDE W. TOMBAUGH, of the Lowell Observatory and the Arizona State College at Flagstaff, has been appointed for the coming academic year visiting assistant professor of astronomy at the University of California at Los Angeles, to take the place of Dr. Samuel Herrick, who is on sabbatical leave.

DR. HAROLD H. WILLIAMS, Detroit, director of the research laboratory of the Children's Fund of Michigan, has been appointed a professor in the department of biochemistry of Cornell University.

DR. RAYMOND B. CATTELL, associate professor of psychology at Duke University, has been appointed research professor of psychology at the University of Illinois under the "Distinguished Professorship Fund," administered by the Graduate School.

DR. JOSEPH S. ILLICK has been appointed dean of the New York State College of Forestry at Syracuse University. He has served as acting dean since 1943.

DR. ORVILLE WYSS has resigned his position as research bacteriologist for Wallace and Tiernan Products, Belleville, N. J., to become associate professor of bacteriology at the University of Texas. Mrs. Orville Wyss has resigned her position as instructor of chemistry at Hunter College of the City of New York.

DR. R. BLACKWELL SMITH, JR., who is now associated with Dr. H. O. Calvery, of the Division of Pharmacology, Food and Drug Administration, has been elected a member of the department of pharmacology of the Medical College of Virginia, Richmond, and assistant dean of the School of Pharmacy. He will assume the work late in 1945 or early in 1946.

DR. FRANK K. EDMONDSON, since 1944 chairman of the department of astronomy of Indiana University, has been promoted to an associate professorship. Dr. Lawrence H. Aller has been appointed assistant pro-

fessor of astronomy. He will design and supervise construction of a spectrograph for the 36-inch reflector of the Goethe Link Observatory during the coming year.

DR. EDWARD H. COX, professor of chemistry at Swarthmore College, who has been acting in an advisory capacity to the Director of Armament of the United States Strategic and Tactical Air Forces (USSTAF) in Paris, has returned to this country. He will resume his work as acting head of the department of chemistry.

DR. SHAO WEN YUAN, who for the past twenty months has been in charge of research aerodynamics in the Helicopter Research Division of the McDonnell Aircraft Corporation, St. Louis, has joined the staff of the Polytechnic Institute of Brooklyn to continue research on the helicopter and to introduce the first academic course on the helicopter incorporated in the regular curriculum of an engineering institution in this country.

DR. ARTHUR GROLLMAN, professor of experimental medicine at the Southwestern Medical College, Dallas, has been named professor of medicine and chairman of the department of experimental medicine.

DR. PAUL O. MCGREW, acting chief curator of geology at the Chicago Natural History Museum, and Bryan Patterson (at present in service with the U. S. Army) have been appointed lecturers in geology on the faculty of the University of Chicago. They will continue their work at the museum.

DR. TAGE U. H. ELLINGER has been appointed professor of zoology at Howard University.

THIRTY-SIX members of the faculty of the University of Illinois have been promoted to full professorships. These include H. R. Snyder, H. E. Carter, chemistry; W. V. Balduf, entomology; A. H. Sutton, H. R. Wanless, geology; J. L. Doob, D. G. Bourgin, mathematics; J. B. Andrews, agricultural economics; F. E. Longmire, J. D. Bilsborrow, agricultural extension; H. H. Alp, animal husbandry; J. R. Fellows, mechanical engineering; J. H. Bartlett, Robert Serber, Moritz Goldhaber, physics; V. P. Jensen, T. J. Dolan, W. L. Schwalbe, N. E. Ensign, theoretical and applied mechanics; A. R. Cooper, R. L. Webb, anatomy; W. S. McCulloch, psychiatry; A. R. Hollender, laryngology, rhinology and otology; W. H. Cassels, surgery.

DR. RANIER ZANGERL, formerly assistant professor of comparative anatomy at the University of Notre Dame, has joined the staff of the Chicago Natural History Museum as curator of fossil reptiles in the department of geology.

DR. PAUL E. THOMPSON, until recently assistant professor of parasitology in Tulane University, has taken up work as bacteriologist of the Mary Imogene Bassett Hospital and of the Otsego County Laboratory at Cooperstown, N. Y.

PROFESSOR ROGER ADAMS, head of the department of chemistry of the University of Illinois, who has been on leave of absence since 1942 as a member of the National Defense Research Committee and chairman of one of its divisions, has been given a further year's leave of absence by the University Board of Trustees. Professor William C. Rose will continue as acting head of the department of chemistry. Though Professor Adams has been on leave, he has continued to supervise the training of graduate students in research and has been directing scientific investigations of his own.

G. R. FESSENDEN, who has been working in the U. S. Department of Agriculture on the development of methods for preserving plant specimens in natural color, has concluded a series of instruction courses in the preservation of agricultural specimens in plastics, held for faculty members of the State College of Florida, New Mexico, Oregon, Washington, Idaho, Montana, North Dakota, Illinois and Massachusetts, with South Dakota, Vermont, New Hampshire, Maine and Rhode Island also participating. On August 1 he joined the Wyeth Institute of Applied Biochemistry in Philadelphia, where he will serve as botanist.

FRED W. LORENZ, assistant professor of poultry husbandry at the University of California, in Davis, Calif., has joined the research staff of the White Laboratories, Inc., Newark, N. J. He will be in charge of research in physiology and endocrinology.

THE trustees of the Beit Scientific Research Fellowships, of which Sir Campbell Stuart is chairman, have awarded fellowships tenable at the Imperial College of Science and Technology, London, for the academic year 1945–46 renewable for a second year as follows: H. Bloom, M.Sc., Melbourne, for research on the photochemical decomposition of the higher silanes or the silico-germanium compounds under the direction of Professor H. V. A. Briscoe; J. A. Elvidge, for research on penicillin, under the direction of Professor I. H. Heilbron; K. D. Froome, for research on the mechanism of very high current conduction in gases, under the direction of Professor Sir George P. Thomson, F.R.S.; D. K. C. MacDonald, M.A., Edinburgh, for research on noise and sensitivity problems in radio engineering, under the direction of Professor C. L. Fortescue; J. S. Webb, for research on the origin and mineral paragenesis of the tin lodes of Cornwall, under the direction of Professor H. H. Read, F.R.S.

EDWIN G. BAETJER, chairman of the Board of Dun and Bradstreet, Inc., who died on July 20, whose estate is estimated at over $3,000,000, left $100,000 to Princeton University; $50,000 to the Johns Hopkins University, and $25,000 to the McDonogh Educational Fund and Institute, Inc., of Baltimore.

THE Reynolds Metal Company of Richmond, Va., is planning to establish at a cost of $1,000,000 a research laboratory for the study of aluminum alloys. The laboratory will be situated on Memorial Drive, Cambridge, Mass.

THE American Society of Heating and Ventilating Engineers, of which Dr. C.-E. A. Winslow, of the School of Medicine of Yale University, is president, has appointed a committee to supervise the raising of a fund for its enlarged program of research at its laboratory in Cleveland and in cooperating institutions. The goal set to meet current research is budgeted at $110,000 for the next three years.

THE R. R. Rowley collection, one of the finest private fossil collections gathered by one individual, including 200,000 specimens collected over a period of sixty-eight years, now in a private museum, is being acquired by the University of Illinois. Much of the collection comes from Missouri, Iowa, Illinois and Kentucky. All is in excellent condition. Among the 200,000 items are 147 type specimens and numerous others set aside by Rowley as new types, but not described by him before his death.

BECAUSE of transportation restrictions the only sessions of the fifty-ninth convention of the Association of Land-Grant Colleges and Universities to be held in Chicago on October 24 and 25 will be those of the executive body. The Association of Official Agricultural Chemists, Inc., and the Association of American Feed Control Officials, Inc., will not meet this year.

A CONFERENCE on the Control of Tuberculosis in a Metropolitan Area, sponsored by the Institute of Medicine of Chicago, will be held on Tuesday and Wednesday, November 13 and 14, at the Palmer House, Chicago, and will cover phases that are of particular importance at this time to clinicians, specialists, lay workers and teachers, who are cordially invited to attend.

A CONFERENCE sponsored by the Armour Research Foundation of the Illinois Institute of Technology will be held in Chicago from October 1 to 6. Twenty leaders of Mexican industry, government and finance are expected to be in attendance. Visits are planned to industries, colleges and research organizations in the area. There will be panel discussions on research methods and the solution of industrial research problems.

DR. GEORGE M. DECHERD, JR., director of the postgraduate training program of the Medical Branch at Galveston of the University of Texas, announces that a conference on internal medicine will be held at the Medical School from November 1 to 3. Dr. George Fahr, professor of medicine at the University of Minnesota, will be among the guest speakers.

SPECIAL ARTICLES

ISOLATION OF AN APPARENTLY NEW VIRUS FROM TWO FATAL PNEUMONIA CASES

DURING the winter of 1944 two viruses were isolated from two fatal cases[1] of pneumonia. One was isolated from each case and they were regarded as different viruses, until studies indicated that they were identical. In this paper they will be described as one virus. This virus resembles some members of the psittacosis group, but it differs sufficiently from any of the previously known viruses so that it is believed to be a hitherto undescribed virus. It has been termed the Illinois virus.

The cases from which it was isolated occurred in Chicago at about the same time. One was a practising physician and the other a student in a dental school. In each instance the clinical picture was essentially the same. The onset was gradual and the predominating signs and symptoms were weakness, malaise, fever and head and chest pains. The two cases differed in that the student showed a fine red rash extending from the neck down to the level of the nipples and he had chills and pain in the joints and back. Pneumonia eventually occurred in both patients. They were admitted to a hospital in Chicago, one about 14 days and the other about 6 days following the onset of illness. They died on the same day, one after 4 days of hospitalization and the other after 9 days.

Epidemiological studies revealed that these cases had indirect contact with each other shortly before the onset of their illnesses. The physician was a staff member of a medical school clinic in which the student had his eyes examined about ten days before he became sick. The examination, however, was not made by the doctor but by his medical assistant. Also the clinic and the dental school were housed in the same building. No evidence of contact with birds or animals could be found in the case of either patient.

From each case the virus was isolated by inocula-

[1] Specimens from these cases and information regarding the clinical and epidemiological findings were provided through the courtesy of the late Dr. Irving S. Cutter and Dr. Opal E. Hepler, of Chicago.

tion of mice by the intranasal route with a suspension of the lung tissues. To confirm the original isolation, it was isolated on three different occasions from each of the original lung specimens which had been stored in dry ice subsequent to the first isolation. Cultural studies were made on these specimens and no significant bacteria could be detected.

Albino Swiss mice were employed in these studies. They were tested periodically to determine if they carried a mouse pneumonitis virus and in no case could the presence of such virus be demonstrated.

The viruses obtained from both patients readily passed through Berkefeld N or W filters. They killed mice when inoculated by the intranasal, intraperitoneal or intracerebral routes. When mice were injected with either virus by the subcutaneous route, about 8 per cent. of them became infected and died, while the others developed immunity against intracerebral inoculation of either virus.

After inoculation of mice by the intranasal route consolidation of the lungs and congestion of the spleen, liver and mesenteric glands were produced. By either the intraperitoneal or subcutaneous method of inoculation congestion of the spleen and liver and in some instances dark red spots of the lungs were caused. Following subcutaneous injection there was also necrosis of the tissues at the point of inoculation. Intracerebral administration caused a severe type of encephalitis. The average survival time after the various routes of inoculation with either virus was as follows: intranasal, 5 days; intracerebral, 5 days; intraperitoneal, 6 days; and subcutaneous, 7 days.

L.C.L. bodies were found in the lung, liver and spleen following the intranasal and intraperitoneal methods of inoculation. After intracerebral injection, they were present in the brain tissue and after subcutaneous in the skin at the point of introduction.

Cross immunity tests were made to determine antigenic relationship of the two viruses. The results indicate that they are immunologically identical.

The above results show that these agents possess identical physical, pathological and immunological characteristics and for this reason they are regarded as the same virus.

The Illinois virus resembles the psittacosis group of viruses in many of its characteristics, and for this reason it was compared immunologically with the Psittacosis 6 BC, Ornithosis 207, S-F 470, and Meningopneumonitis MP-F97 strains of viruses. These viruses were selected for this comparison because their pathogenicity for mice closely simulated that of the Illinois virus. The immunological tests were carried out by immunizing mice by subcutaneous inoculation of living Illinois virus and then testing them for protection against intracerebral injection of the above viruses. To detect degrees of immunity the virulence of each virus was titrated simultaneously in immunized and normal mice. The results of these tests are shown in Table 1.

TABLE 1

CROSS IMMUNITY TESTS WITH MICE IMMUNIZED WITH ILLINOIS VIRUS

Virus dilution	Challenging viruses—0.03 cc intracerebrally									
	Illinois		Psittacosis		Ornithosis		S.F.		Meningopneumonitis	
	I	N	I	N	I	N	I	N	I	N
10^{-1}	0/8	8/8	8/8	8/8	8/8	8/8	'4/8	8/8	8/8	8/8
10^{-2}	0/8	8/8	8/8	8/8	8/8	8/8	'3/8	6/8	8/8	7/8
10^{-3}	0/8	8/8	8/8	8/8	4/8	5/8	'1/8	4/8	7/8	8/8
10^{-4}	0/8	6/8	7/8	6/8	2/8	4/8	0/8	6/8	6/8	8/8
10^{-5}	0/8	7/8	8/8	7/8	1/8	2/8	0/8	4/8	3/8	8/8
10^{-6}	0/8	4/8	2/8	3/8	0/8	0/8	0/8	4/8	3/8	4/8
10^{-7}	0/8	1/8	0/8	1/8	0/8	0/8	0/8	0/8	2/8	1/8
10^{-8}	0/8	0/8	0/8	0/8					0/8	0/8

Deaths/mice used.
I—Immunized mice.
N—Normal mice.

As demonstrated in Table 1 mice immunized with the Illinois virus did not show any evidence of protection against psittacosis, ornithosis or meningopneumonitis viruses, but they did exhibit some protection against the S-F virus. Only a few of the immunized mice died after injection with dilutions of S-F virus ranging from 10^{-1} to 10^{-3}; however, most of the survivors developed paralysis of one or more limbs. On the other hand, most of the control animals receiving dilutions from 10^{-1} to 10^{-6} died, while some of the surviving control mice also developed paralysis of their legs.

These results indicate that the Illinois virus is different from the psittacosis, ornithosis and meningopneumonitis viruses. Although it exhibits some immunological relationships with the S-F virus, it is considered to be different because in addition to their incomplete cross immunity the Illinois virus kills mice with regularity following intraperitoneal inoculation whereas the S-F virus does not.[2]

More complete information regarding the epidemiological, clinical and pathological findings of the cases and the results of further studies on the identification of this virus will be presented in a final report.

JOSEPH ZICHIS
HOWARD J. SHAUGHNESSY
ILLINOIS STATE HEALTH DEPARTMENT,
DIVISION OF LABORATORIES,
CHICAGO

SEX DIFFERENCES IN KIDNEY MORPHOLOGY AND CHLOROFORM NECROSIS

NECROSIS of the convoluted tubules of the kidneys has been found to occur in male mice but not in

[2] M. D. Beck, M. D. Eaton and R. O'Donnell, *Jour. Exp. Med.*, 79: 65, 1944.

females, following oral administration of chloroform.[1] Morphologic differences in the kidneys of mice have been described for normal males, normal females, castrated males, testosterone-treated castrated males[2, 3, 4] and for testosterone-treated females.[5] The present report deals with the finding of a correlation between kidney morphology and susceptibility to chloroform necrosis.

Sex differences in the morphology of the mouse kidney have been clearly established only recently by Crabtree[2] who showed that the parietal layer of most of the Bowman's capsules in female mice is composed entirely of squamous cells, while in most of the capsules in male mice it is composed partly or entirely of cuboidal cells similar to those of the proximal convoluted tubules. Crabtree has subsequently shown that the per cent. of capsules having cuboidal cells does not reach a high value in the male until sexual maturity,[3] that in castrated male mice this value remains low and closely approaches that of normal female mice, but that when castrated male mice are treated with testosterone this value returns to near that of normal males.[4] Selye[5] had earlier shown that treatment of female mice with large doses of testosterone resulted in increase of kidney weight, the presence of cuboidal cells lining Bowman's capsules and enlargement of cells of the convoluted tubules of the kidneys. Wicks[6] has found that persistent and marked proteinuria is present in males, while a trace or none is found in females of several inbred strains of mice. He observed that the proteinuria gradually decreased following castration.

In our experiment four groups of strain A mice were used: normal females, normal males, castrated males and testosterone-treated castrated males. Five animals were used in each of the four groups. Castration was performed under ether anesthesia through a mid-line abdominal incision when the males were 5 weeks of age. Treatment with testosterone propionate was begun at 10 weeks of age, 1 mg in 0.25 cc of sesame oil being injected subcutaneously every other day for a total of 10 injections. At 13 weeks of age all animals were given 0.005 cc of a 12 per cent. solution of chloroform in olive oil per gram body weight by stomach tube. Twenty-four hours later 2 of 5 testosterone-treated castrated males were dead and the remaining 3 and all 5 normal males were in moribund condition. All animals remaining alive 24 hours after administration of chloroform were killed. Both kidneys of all 20 mice were fixed in Zenker-formol, dehydrated in ethanol and embedded in paraffin. One kidney of each animal was sectioned transversely, and the other longitudinally. Sections were stained with hematoxylin and eosin and with Mallory's aniline blue.

All glomeruli in one section of each kidney were counted and tabulated as having squamous or cuboidal cells, as described by Crabtree. The total number of glomeruli counted in groups of five animals ranged from 976 to 1,179. The sums of the two types of glomeruli in all five animals of each group were obtained and their proportions expressed as per cent. are shown in Fig. 1.

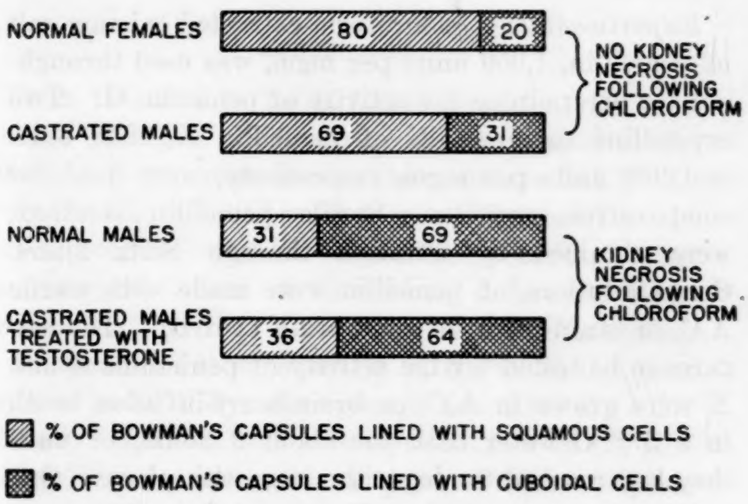

FIG. 1

There was extensive necrosis of portions of the proximal and distal convoluted tubules in normal male and in testosterone-treated castrated male mice and no necrosis in female and in castrated male mice. No necrosis was observed in Bowman's capsules or in the upper portions of the proximal convoluted tubules.

These observations with their correlations of morphologic and physiologic differences raise some interesting questions for further experimentation. However, no additional work along this line is contemplated by the authors, and the results obtained are therefore briefly reported.

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[1] A. B. Eschenbrenner, *Jour. Nat. Cancer Inst.*, 5: 251, 1945.
[2] C. Crabtree, SCIENCE, 91: 299, 1940.
[3] C. Crabtree, *Anat. Rec.*, 79: 395, 1941.
[4] C. Crabtree, *Endocrinology*, 29: 197, 1941.
[5] H. Selye, *Jour. Urol.*, 42: 637, 1939.
[6] L. F. Wicks, *Proc. Soc. Exp. Biol. and Med.*, 48: 395, 1941.

THE ACTIVITY OF PENICILLINS G AND X IN VITRO

INTRODUCTION

WELCH, Putnam, Randall and Herwick have reported[1] that *in vitro* studies show penicillin X to be

[1] H. Welch, L. E. Putnam, W. H. Randall and R. P. Herwick, *Jour. Am. Med. Asn.*, 126: 1024, 1944.

more effective than commercial penicillin against a strain of *Klebsiella pneumoniae* type A and a strain of *Bacillus cereus*. No difference in effect could be shown, however, on four strains of *Staphylococcus aureus*. The same authors[1] have shown penicillin X to be more effective in protecting mice against type I pneumococci and in the treatment of gonorrhea in humans.

This report shows the concentration of penicillin G and penicillin X in units and micrograms per ml necessary to inhibit the growth of strains of the following organisms: *Staphylococcus aureus, Bacillus subtilis,* types I, II and III pneumococci, groups A, B and D streptococci, *Erysiphelothrix rhusipathiae* and *Escherichia coli.*

Experimental: A chloroform-extracted calcium salt of penicillin, 1,050 units per mgm, was used throughout for determining the activity of penicillin G. Two crystalline sodium salts of penicillin X,[2] 846 units and 990 units per mgm, respectively, were used for comparative purposes. Sterile penicillin solutions were obtained by filtration through Seitz filters. Serial dilutions of penicillin were made with sterile A.C. or brain-heart-infusion broth (Difco). The cultures to be tested for the activity of penicillins G and X were grown in A.C. or brain-heart-infusion broth in a 37° C water bath for about 3 hours, or until they had reached the logarithmic growth phase. One milliliter of a one to ten dilution of the culture was then inoculated into 1-ml volumes of the serial dilutions of penicillin. These experimental cultures were incubated at 30° C for 18 hours. The results are recorded as the lowest concentration of penicillin G or X that prevented the visual appearance of growth at the end of 18 hours' incubation. *Results:* The first column of Table 1 shows the number of organisms in millions per ml, as indicated by plate counts, at zero time. Columns 2 and 3 show the concentration of penicillin G or X in units per ml of medium required to inhibit visible growth for a period of 18 hours' incubation at 30° C. Table 2 shows the concentration of penicillin G or X in micrograms of penicillin per ml required to inhibit the appearance of visible growth. The final columns in Tables 1 and 2 show the comparative activity of penicillins G and X, as expressed by the ratio of the units or micrograms of penicillin G to penicillin X to inhibit growth.

TABLE 1
UNITS OF PENICILLIN PER ML TO INHIBIT GROWTH

Organism	Inoculum millions/ml	Units* penicillin G	Units* penicillin X	Ratio G/X
Staphylococcus aureus—NRRL–313	1.4	.0625	.0625	1.0
Bacillus subtilis—3R9675	1.3	.0982	.0982	1.0
Pneumococcus Type I (SVI)	1.7	.03125	.0156	2.0
Pneumococcus Type II	0.7	.01225	.0050	2.4
" " III	0.5	.0121	.0050	2.4
Streptococcus Group D	0.4	4.0000	1.7000	2.4
" " B	1.0	.2030	.0664	3.0
" " A	0.6	.0176	.0063	2.8
Erysiphelothrix rhusipathiae	1.7	.1607	.0491	3.3
Escherichia coli	1.7	133.9000	46.8750	2.9

*Mean values for 7 trials carried out on different days.

TABLE 2
MICROGRAMS* OF PENICILLIN PER ML TO INHIBIT GROWTH

Organism	Penicillin G	Penicillin X	Ratio G/X
Staphylococcus aureus—NRRL–313	.040	.060	0.7
Bacillus subtilis—3R9675	.059	.098	0.6
Pneumococcus Type I (SVI)	.019	.016	1.2
" II	.007	.005	1.4
" III	.007	.005	1.4
Streptococcus Group D	2.400	1.700	1.4
" B	.120	.066	1.8
" A	.010	.006	1.7
Erysiphelothrix rhusipathiae	.097	.049	2.0
Escherichia coli	81.000	46.900	1.7

* Calculated on the basis of 1,650 units/mgm for pure penicillin G and 1,000 units/mgm for pure penicillin X.

Discussion: In agreement with Welch *et al.*[1] penicillin G and X appear equally effective on a unit basis in inhibiting the growth of *Staphylococcus aureus*; likewise, both penicillins are equally effective against the strain of *Bacillus subtilis* used. On a weight basis, however, penicillin G is more effective than penicillin X on the strains of these two organisms used in this study.

For the remaining organisms tested, penicillin X is more effective both on a unit and on a weight basis than is penicillin G in inhibiting growth *in vitro*. Depending on the organisms tested, 2 to 3 times more penicillin G than penicillin X is required on a unit basis to inhibit visible growth, while on a weight basis 1.2 to 2 times more G than X is necessary.

Summary: The data presented indicate that penicillin X is more effective than penicillin G against a number of different organisms.

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[2] The sodium salt of penicillin X used in these experiments was prepared by E. F. Williams, of the Physics Research and Testing Division of these laboratories.

THE SPECIFICITY OF THE XANTHYDROL-PYRIDINE REACTION FOR 2, 2 BIS (p-CHLOROPHENYL) 1,1,1 TRICHLOROETHANE (DDT)

STIFF and Castillo[1] reported a new sensitive colorimetric test for 2,2 bis (p-chlorophenyl) 1,1,1 trichloro-

hane (DDT) based upon the formation of a red color y heating DDT with anhydrous pyridine solution ontaining xanthydrol and solid KOH. The reaction sensitive to as little as 10 micrograms and is quantative within the range of 10–240 micrograms of DT. No mention was made of the specificity of is reaction.

In view of the studies on the metabolism of DDT d its analogues which are being carried out in this boratory it is of interest to examine the behavior the various analogues and derivatives of DDT wards Stiff and Castillo's new reaction. The results the test applied to eighteen compounds are shown Table 1.

TABLE 1

E REACTION OF DDT, ITS DERIVATIVES AND ANALOGUES WITH XANTHYDROL-PYRIDINE; THE ABSORPTION MAXIMA AND EXTINCTION COEFFICIENTS OF THE POSITIVE REACTIONS

	Compound	Reaction	Absorption max. mμ	Extinction coefficient
(1)	$(p\text{-}ClC_6H_4)_2CHCCl_3$	+	500	10.4×10^3
(2)	$(p\text{-}ClC_6H_4)(C_6H_5)CHCCl_3$	+	500	9.2×10^3
(3)	$(p\text{-}ClC_6H_4)_2CHCBr_3$	+	506	2.9×10^3
(4)	$(p\text{-}BrC_6H_4)_2CHCCl_3$	+	520	10.8×10^3
(5)	$(C_6H_5)_2CHCCl_3$	+	495	3.1×10^3
(6)	$(p\text{-}CH_3C_6H_4)_2CHCCl_3$	+	488	2.5×10^3
(7)	$(p\text{-}CH_3OC_6H_4)_2CHCCl_3$	+	485	2.1×10^3
(8)	$(p\text{-}C_2H_5OC_6H_4)_2CHCCl_3$	+	485	1.4×10^3
(9)	$(p\text{-}C_3H_7OC_6H_4)_2CHCCl_3$	+	480	2.0×10^3
(10)	$(p\text{-}C_4H_9OC_6H_4)_2CHCCl_3$	+	482	2.0×10^3
(11)	$(p\text{-}ClC_6H_4)_2C=CCl_2$	+	500	6.6×10^3
(12)	$(C_6H_5)_2C=CCl_2$	+	490	1.9×10^3
(13)	$(p\text{-}BrC_6H_4)_2C=CCl_2$	+	482	1.5×10^3
(14)	$(p\text{-}HOC_6H_4)_2CHCCl_3$	+	–	–
(15)	$(p\text{-}CH_3COOC_6H_4)_2CHCCl_3$	+	–	–
(16)	$(p\text{-}ClC_6H_4)_2CHCOOH$	–	–	–
(17)	$(p\text{-}ClC_6H_4)_2CH_2$	–	–	–
(18)	$(p\text{-}ClC_6H_4)_2C=O$	–	–	–

Compound No. 14 gave a dirty reddish violet color with ish fluorescence.

Compound No. 15 gave a reddish violet color and then recipitate of brownish red.

EXPERIMENTAL

The compounds[2] used in Table 1 were weighed on basis of 5.65×10^{-7} moles per 5 cc of anhydrous er. Five cc of each solution were pipetted into ividual test tubes 16 × 150 mm, and the colorimetric ction as described by Stiff and Castillo was carried on each tube in duplicate after evaporation of ether. As pointed out by these authors, the sence of water and moisture has an inhibiting et on color formation. We found this to be true, especially on hot humid days. Consistent results were obtained, however, by the introduction of a pellet of KOH to the tube containing 2 cc of the reagent and 4 cc of pyridine during the heating and development of color. The visible absorption curves of those compounds giving a positive reaction were obtained in a Coleman Spectrophotometer Model 11 with an effective width of 35 mμ. The extinction coefficient at 500 mμ of each of the various compounds were calculated from absorption measurements made in the same instrument in 1 cm thick absorption cells. The concentration of each compound in the reaction was such that light transmitted under this condition was approximately 50 per cent. of the incident light.

DISCUSSION

From the data in Table 1 it is seen that all compounds giving a positive reaction contain aliphatic halogen. Compounds having the structure $>CHCX_3$ or $>C=CX_2$ (X = Cl or Br) in all likelihood would give a positive reaction. On a molar concentration the strongest colors in descending order are Compounds (4), (1), (2) and (11). With the exception of compounds (4) substitution of the Cl in the para position in DDT by other groups decreases the color intensity. Likewise the substitution of Br in the side chain decreases the color intensity. The complete removal of the halogen from the aliphatic part of the molecule renders the compound negative in the reaction.

In view of these observations made on eighteen compounds the xanthydrol-pyridine reaction has no specificity for DDT.

SUMMARY

The Stiff and Castillo colorimetric test for DDT was extended to eighteen analogues and derivatives of DDT. The absorption maxima and extinction coefficients of the colored reactions were also obtained. The test is not specific for DDT. Of the compounds tested, the reaction was given by those having the structure $>CHCX_3$ or $>C=CX_2$.

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H. A. Stiff and J. C. Castillo, SCIENCE, 101: 440, 5.

Compounds Nos. 1, 2, 3 and 13 were kindly furnished Dr. H. L. J. Haller, of the Department of Agriculture. pound No. 18 was obtained from Eastman Kodak pany. Compounds Nos. 16 and 17 were supplied by T. R. Sweeney of this laboratory. The rest of the pounds were synthesized by one of us (N.E.S.) folg published material.

PHYSIOLOGICAL EVIDENCE OF A SITE OF ACTION OF DDT IN AN INSECT

WHEN DDT (1-trichloro-2,2-bis (*p*-chlorophenyl) ethane) solution[1] is injected into a roach, *Periplaneta*

[1] The following definitions apply to this paper: DDT solution, a high concentration (*ca.* 10 per cent.) of DDT in corn oil. Nicotine solution, a high concentration (*ca.*

americana (L.), the ensuing symptoms of toxicity involve increased activity, the eventual appearance and persistence of contractions and tremors in the appendages and body, erratic behavior, and loss of equilibrium. The typical DDT contractions and tremors[1] have been used as a sign of a toxic but not necessarily a lethal action of the poison. Qualitative experiments of the following kinds were performed, with the results indicated. In each experiment controls were treated with corn oil alone and yielded negative results. For brevity, individual experiments are not described, and results and conclusions are much condensed.

Experiments and results.—(1) DDT solution injected into an isolated leg, *a*, taken from a normal roach, an attached leg, *b*, of a cauterized roach,[1] or the leg, *c*, of a leg-ganglion preparation[1] caused symptoms in, and only in, each injected leg. Severing legs *b* and *c* at the point of their attachment to the body did not stop the symptoms. The DDT symptoms in leg *a* were made to vanish at once by sectioning the leg just distad to the region injected. Conclusion 1: DDT can[2] provoke symptoms[1] in a leg without having to act at any site not located within that leg.

(2) Local injection of DDT solution into the region of a thoracic ganglion, *d*, of a cauterized roach, or local application to the ganglionic region of a leg-ganglion preparation, I, caused symptoms in, and only in, the two legs innervated by *d* and in the leg of I. Severing an affected leg at its point of attachment to the body stopped the symptoms, which continued when such legs were not severed. Conclusion 2: DDT can cause symptoms in a leg without having to act at any site located within that leg.

From conclusions 1 and 2 it follows that the DDT can provoke these symptoms by acting at a site (or sites) common to leg and body, without having to act at other sites. A site, common to leg and body, that readily accounts for these results is that part of a nerve between its ganglionic origin in the central nervous system and the terminations of its fibers in the leg.

(3) Nicotine solution was injected into an isolated leg, *e*, from a normal roach, an attached leg, *f*, of a cauterized roach, and the region of a thoracic ganglion, *g*, of a cauterized roach, II. It was put on the ganglionic region, *h*, of a leg-ganglion preparation, and was also injected into a normal roach, III. Legs *e* and *f* showed no reaction to the nicotine. Roaches II and III at once exhibit violent tremors involving all the legs, but severing a tremoring leg caused the symptoms in that leg to vanish. Similarly, violent tremors appeared in the leg innervated from *h* but vanished when the tremoring leg was severed at its attachment to the body segment. Conclusion 3: Nicotine can produce violent tremors in all legs of a roach by excitatory action at a single thoracic ganglion, and seems not to excite the motor fibers of the nerves.

(4) Repetition of the experiments under (3), using DDT solution instead of nicotine solution, gave the following results: Legs *e* and *f*, the two legs innervated by *g*, the leg innervated from *h*, and the legs and body of roach III soon exhibited DDT symptoms. The symptoms in leg *f* and in a leg of roach III continued after the legs were severed, but severing a leg innervated by *g* or from *h* caused the symptoms to vanish from the severed leg. The DDT symptoms in leg *f* were the only ones exhibited by that insect, and the symptoms of roach II occurred only in the two legs innervated by *g*, whereas the symptoms in roach III involved the entire body. Conclusion 4: DDT did not cause ganglionic excitation, as did nicotine, but apparently did excite the motor fibers of the nerves.

(5) Normal roaches were injected with DDT solution. Typical DDT symptoms appeared. Then the insects were injected with nicotine solution. Violent nicotine tremors, followed by paralysis, of all the appendages ensued, and masked the DDT symptoms. Severing a violently tremoring leg caused the nicotine tremors to vanish, after which the DDT symptoms reappeared and continued. Severing a paralyzed leg also was followed by the reappearance of the DDT symptoms. Similar results were obtained by applying nicotine solution to DDT-affected leg-ganglion preparations. Conclusion 5: Nicotine symptoms may mask DDT symptoms, but nicotine action does not necessarily stop DDT action, nor does prior DDT action necessarily prevent the action of nicotine.

(6) A small amount of DDT solution was injected through a pinhole made in the eye of a cauterized roach. Later DDT symptoms appeared in one or both antennae (different experiments). The DDT symptoms did not appear posterior to the head. Other roaches were treated similarly, except that they were injected with nicotine solution instead of DDT solution. Violent tremors appeared, involving

10 per cent.) of nicotine in corn oil. Nicotine symptoms, only the violent tremoring and paralysis caused by nicotine. DDT symptoms, only the typical contractions and tremors caused by DDT; these consist usually of slower contractions upon which are superimposed at times tremors or rapid twitches. Cauterized roach (a roach with its entire heart region cauterized to prevent cardiac circulation of the hymolymph. Leg-ganglion preparation, a dissected preparation consisting of the ventral part of a thoracic body segment with its ganglion and one attached leg, and with the nerve connections between ganglion and leg intact.

[2] "Can" is used in this paper to denote that the conditions referred to are sufficient to produce the specified results without implying whether or not these are the only conditions that may produce them.

hole body. Decapitation of a roach showing violent cotine tremors caused the tremoring posterior to the ck to stop at once. Conclusion 6: DDT applied in is way does not cause general excitation, as does cotine.

General discussion.—These results indicate that the tion of DDT was different from that of nicotine, e latter affecting the ganglia and DDT affecting the rves somewhere along their length. The results sugst that the DDT can act more readily on the motor an on the sensory fibers and, further, that the DDT n bring about repetitive discharges of nerve imlses somewhere along the motor fibers.

General conclusion regarding a mode of toxic action DDT in the roach.—Certain symptoms of toxicity, ferred to as typical DDT contractions and tremors a leg, can result from the action of DDT at a site (or sites) common to leg and body. It is strongly indicated that the site (or sites) referred to consist of that region of a nerve lying between the origin of its fibers in the ventral nerve cord and the terminations of its fibers in the leg exclusive of the origin and the endings, that is, the myo-neural junctions, of the fibers. It may be said also that all these results are consistent with the idea that DDT can provoke contractions and tremors in other appendages, or in the body, by acting at a similar site on other nerves.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ADJUSTABLE RESISTANCE WITH LINEAR RESPONSE TO AIR FLOW FOR RESPIRATION EXPERIMENTS

It is often necessary in respiration experiments and nical work to apply resistance to inspiration or exration. It is desirable to have this resistance inase linearly with increasing air flow as Davies, ldane and Priestley[1] have pointed out. The value such a characteristic is that it represents the change resistance produced in humans in diseases such as hma and bronchitis. It is also the type of resisice applied to man by protective respiratory devices h as gas masks and respirators. Davies *et al.* have d canisters filled with cotton wool to give linear ponse to inspiratory resistances. Obviously, such istances are not suitable for expiratory resistances ause moisture will wet the wool and alter the reance. Killick[2] has used a pair of flanged inverted nels with filter papers clamped between them for piratory resistances and these also yield a linear ponse. We[3] have used the same type of funnels with a glass filter cloth placed between the funnels. heating the funnels with an electric heating elent they may be used for inspiratory and expiratory istances without interference of moisture absorpn or condensation.

Several investigators, principally Hill,[4] Matthes[5] l Barach,[6] have used orifices of varying sizes for roducing resistance to respiration. The resistance to air flow of an orifice varies nearly as the square of the flow or parabolically, hence a doubling of flow increases the resistance fourfold. The use of varying sizes of orifices for adjustable resistance is not entirely satisfactory because of this parabolic flow-resistance relationship. For our experiments a linear response was desired and changes were to be made during the experiment by gradual increase (occasionally decrease) of resistance while the subject was sedentary or exercising. It was not practicable to add layers of glass filter cloth to funnel devices in place or change to different funnel devices because of the time and manipulation necessary.

Flow-measuring instruments[7] were placed in the inspiratory and expiratory tubes thus making it impractical to remove and insert different resistances without the subject's knowledge while an experiment was in progress.

The apparatus described here gives linear resistance response with air flow and is adjustable in resistance from 0.1 to 1.0 mm of water per liter of air flow per minute.

Description of Apparatus

A diagrammatic sketch of the apparatus is shown in Fig. 1. It consists of two concentric plastic tubes (lucite) with an annular space between them. The central tube is sectioned so that four supporting strips approximately 3 mm wide remain. A piece of glass filter cloth (WB–0048, Filter Media Corporation, New York) is wound cylindrically around this section and the edges are cemented to the lucite tube by means of

H. W. Davies, J. S. Haldane and J. G. Priestley, *Jour. ysiol.*, 53: 60–69, 1919–20.
E. M. Killick, *Jour. Physiol.*, 84: 162–172, 1935.
Leslie Silverman. Unpublished data. 1943.
L. Hill, *Jour. Physiol.*, 87: 17P–18P, 1936.
H. V. Matthes, *Arbeitsphysiologie*, 11: 118–128, 1940.
6 A. L. Barach, *New Eng. Jour. Med.*, 230: 216–233, February 24, 1944.
7 L. Silverman, R. C. Lee and C. K. Drinker, *Jour. Clin. Invest.*, 1944.

Pyseal (Fisher Scientific Company). This cloth is approximately 19×12 cm and the center tube is 3.8 cm outside diameter, 3 mm wall thickness and 29.2 cm long. The outer tube is 6.4 cm outside diameter,

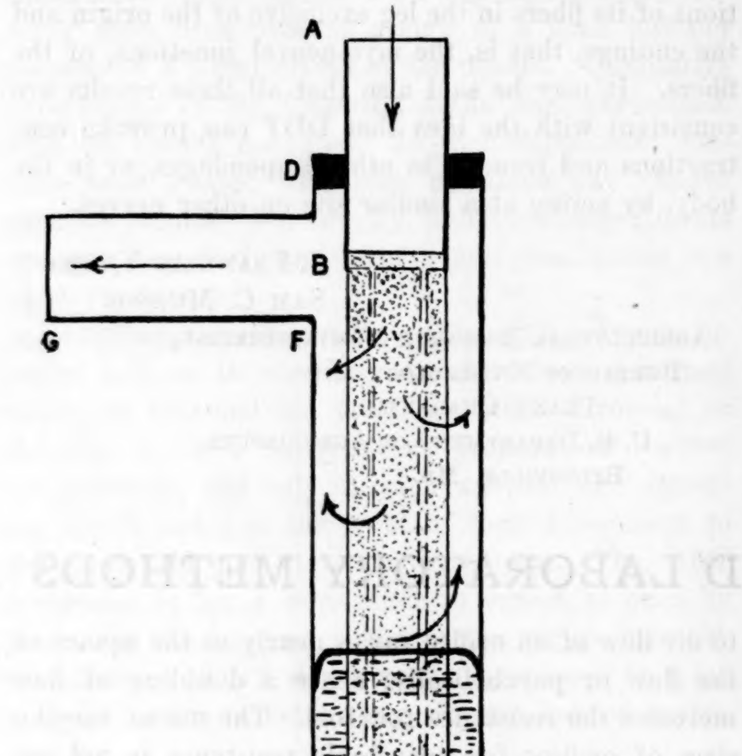

FIG. 1. Diagrammatic sketch of the linear response adjustable resistance. Air may enter either end although an air flow direction is indicated.

3 mm wall thickness and 33 cm long. An outlet tube of the same diameter as the inner tube completes the connections. An approximate scale is shown in Fig. 1. Mercury fills the annular space between the two tubes, and thus the amount of area of the cloth is increased or decreased. A paper millimeter scale is attached to the wall of the outer tube for reading the height of the mercury meniscus. Scale zero is approximately at C. The ends D and E are closed by rubber stoppers which are wired in place. The glass elbow in the lower stopper E connects with stopcock H and a mercury reservoir. Air enters the apparatus at A and leaves at G after passing through the filter cloth. The air can enter at G and leave at A if desired. When used on expiration a small heated section of tube precedes the resistance to prevent water condensation on the glass cloth. This is necessary if experiments continue for any length of time over fifteen minutes. Below that length of time the amount of water condensed does not appreciabl[y] affect the resistance of the cloth.

Mercury is used for an area adjusting medium be[-]cause of its high specific gravity and surface tension. The amount of movement of the mercury column be[-]cause of pressure differentials during breathing is no[t] significant within the range of pressures shown i[n] Fig. 2. A mechanical device can be made to reduc[e]

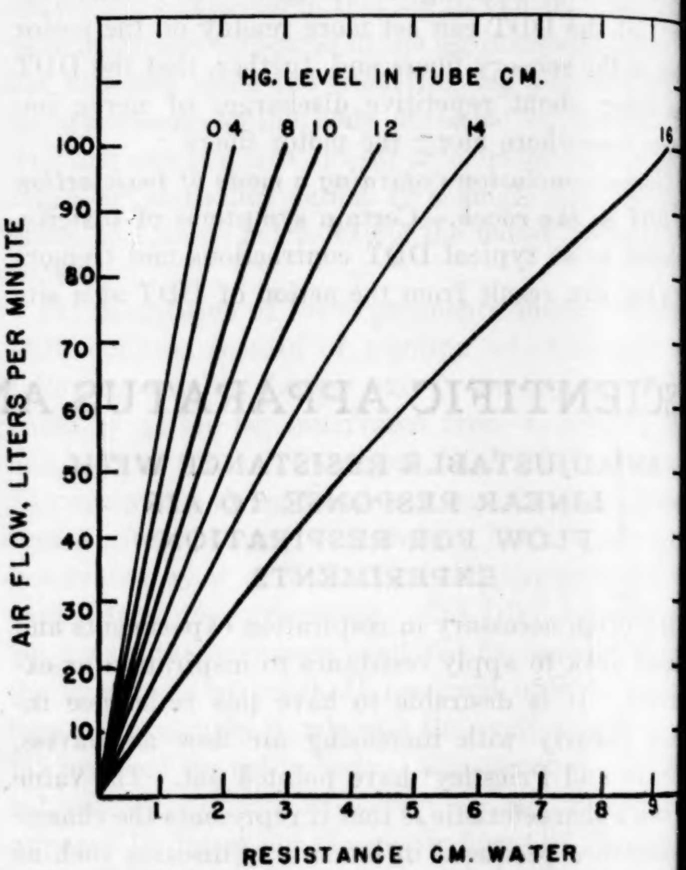

FIG. 2. Resistance-air flow response of apparatus wi[th] decreasing filter cloth area (adjusted by rising mercur[y] column).

the area of the cloth and eliminate the mercury, b[ut] its construction would be complicated.

A typical calibration of one of the laboratory uni[ts] is shown in Fig. 2. The resistance on suction wa[s] measured by a tap near the outlet G, while a be[ll] mouth was placed at A to eliminate the entrance los[s]. Since the unit is usually used in series in a breathin[g] line the bell mouth gives conditions corresponding [to] line resistance differentials. If the resistance is n[ot] preceded by other apparatus a bell mouth is desirab[le] since it will eliminate the orifice loss and non-linearit[y] of the inlet. On blowing this precaution was n[ot] necessary. With the bell mouth in place resistanc[e] values on suction and blowing agree closely. Th[e] resistance response shown in Fig. 2 indicates that t[he] apparatus resistance is almost linear with air flo[w]. Deviations begin to occur at high air flows (above [...] liters per minute) and when the area of the cloth [is] reduced to a small amount. In the latter case t[he] deviation is caused by high velocity through the clo[th] causing departures from laminar flow through t[he]

cloth openings. The departure at high flows is caused partially by the high velocity through the cloth and very slightly by the resistance loss of the tubing and the elbow loss at connection F. The amount of departure from linearity at zero mercury level is small, thus indicating that the tubing and orifice loss are negligible. The size of the apparatus can be changed to other dimensions for other purposes. If the tubing diameter is decreased the departure from linearity will occur at lower air flows.

One disadvantage to the use of the apparatus for inspiration is the presence of mercury for an area-adjusting medium. During expiration, of course, there is no significant mercury exposure. Measurements of the mercury vapor concentration were made with the General Electric mercury vapor detector.[8] Air was drawn through the tube at a rate of 25 liters per minute and readings were taken at several positions of the mercury level. The mean concentration indicated was 6 milligrams per 10 cubic meters of air. This value is six times the permissible exposure for an occupational exposure. The time of exposure in our experiments is less than one hour, whereas the threshold value of 1 milligram per 10 cubic meters is based on a daily exposure.[9] On this basis, therefore, the amount of mercury absorbed in one hour's exposure is less than the permissible daily absorption.

SUMMARY

A simple easily adjustable linear response resistance apparatus is described. The resistance unit contains a glass filter cloth, the effective area of which is adjusted by a mercury column.

The resistance of the unit can be adjusted from 0.1 to 1.0 millimeters of water per liter of air flow per minute. The resistance can be easily increased or decreased during the progress of an experiment. The mercury hazard during inspiration was evaluated and not found significant for experiments of one hour.

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THE DETECTION OF PENICILLINASE-PRODUCING PROPERTIES OF MICRO-ORGANISMS

IN quest of active penicillinase-producing organisms a simple method for the rapid determination of the ability of organisms to produce this penicillin-inactivating enzyme was evolved. Most previously used methods involve the assay of a penicillin solution before and after exposure to the inactivating substance.

This method is based on the ability of penicillinase to diffuse from the organism in question into a penicillin agar medium previously inoculated with a penicillin sensitive organism. The penicillin added to the medium is sufficient to inhibit the seeded sensitive organism so that no growth occurs. If a penicillinase-producing organism is streaked onto the surface of this medium, penicillinase is elaborated in its growth which diffuses into the agar, inactivates the penicillin and thus permits the seeded sensitive organism to grow out. The growth occurs as a stippled zone of satellite colonies around the streak. Details of the method are as follows:

To 10 cc of melted tryptose-phosphate agar at 45° C., 0.1 cc of a 24-hour broth culture of a sensitive *Staphylococcus aureus* (the strain used was sensitive to 0.04 units of penicillin per cc) is added. Penicillin solution is then added to give final concentrations of 0.5 units per cc. Plates are poured and allowed to harden at room temperature. A minimum of surface moisture is necessary. The organism under study is then introduced by a single streak. Several organisms may be tested simultaneously on the same plate provided sufficient space is allowed for ascertaining the zone of inactivation. Best results have been obtained by making the streaks from the center outward like the spokes of a wheel. The plates are incubated at 37° C. for 24 to 48 hours and inspected for satellite Staphylococcus colonies. If the streaked organism does not produce penicillinase, satellite Staphylococcus colonies are not observed. If the streaked organism produces sufficient penicillinase, satellite colonies of Staphylococcus occur around the line of the streaked organism. The width of the zone of satellite colonies will vary, depending on the amount of penicillinase produced and the concentration of the penicillin in the agar.

Rough quantitative determinations of the amount of penicillinase produced can be made by measuring the width of the zone of satellite growth. More accurate quantitative studies can be made by using a series of plates with varying penicillin concentrations.

This method can also be used for the primary isolation of penicillinase producing organisms. Poured or streaked plates of the sample containing the organisms are made with the seeded penicillin agar medium. Only those colonies that grow readily and produce a zone of satellite Staphylococcus colonies need be picked for further study.

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[8] T. T. Woodson, *Rev. Sci. Instruments*, 10: 308–311, 1939.

[9] American Standard: Allowable concentration of mercury. 37.8—1943. American Standards Association, New York. Approved January 6, 1943.

DISCUSSION

PRESSURE DUE TO MOUNTING SCIENTIFIC KNOWLEDGE

IN his recent communication concerning the pressure due to mounting scientific knowledge, Professor H. M. Dadourian[1] fails to make clear whether the suggestions he advances apply to all students or only to those who intend to become professional scientists. Such a distinction is essential to the understanding of his proposed program. If his plan is intended for only the prospective scientists, may we point out the difficulty of identifying these students while they are still at the grade-school level. But whether his remarks are directed toward all or only to a select group there are various practical considerations of which little note is taken.

If only the phonetic English is taught to future generations all the great English literature of the past, both scientific and otherwise, must be translated or become inaccessible to our grandchildren. Such translation would obviously entail much effort and expense. Is not Dr. Dadourian overly optimistic in his prediction that the adoption of a phonetic alphabet would save "much time and energy for all concerned"?

The streamlining of the curriculum presents certain difficulties. Who is to decide what subjects in the curriculum are "indispensable" and by what criteria? Many scholars would differ with the opinion that "foreign languages, dead or living, are not indispensable." One may well ask, also, which languages are dead and which living. Are Latin and Greek which inescapably confront us not only in scientific terminology but also in English of common usage less dead than a modern language which many students "take" for three or four years and still can not speak?

Moreover, in eliminating from text-books every topic which is not "indispensable to further progress in the subject or which could not be treated more effectively in advanced texts" are we not losing sight of the student who does not intend to major in science? The fact must be recognized that most students do not make science their profession.

Professor Dadourian states that "Somehow the natural curiosity of the child is being destroyed and the common sense of the pupil is being bred out of him, as applied to his studies. The teaching of science continuously in primary and secondary schools would help correct these conditions." Does he wish to imply that other subject-matter can not be taught in such a way as to achieve the same end? It is perhaps true that the natural curiosity and logic of the child are too often subjected to the erosive influences of uninspired and thoughtless pedagogy, but it is also true that extending the period of time over which a subject is taught does not necessarily augment the insight of the teacher.

Has Dadourian also overlooked the fact that science is now taught in at least nine years of the twelve-year-curriculum offered by most present-day public schools?

We must take care that in our zeal to turn out efficient scientists we do not produce instead what Jacques Barzun[2] terms the single-track expert and the scientific ignoramus. For, as he quotes it, "What do they know of science who only science know?"

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LET us consider the points raised by Professor and Mrs. Craft in the order in which they appear in their communication.

I believe that the adoption of the suggestions made in my note would result in the improvement of the education of all—non-scientists as well as scientists. This belief was definitely implied in my remarks about the ignorance of science and of the scientific method on the part of our leaders and the vast majority of educated people.

It is true that if only phonetic English were taught to future generations, there would be some difficulty in reading books printed in the old spelling. It is not true, however, that all the great English literature would become inaccessible to our grandchildren. First, because old books, which are constantly being reprinted, would be printed in the new spelling and the reprinting in the new spelling would be accelerated. Secondly, because a person brought up in the new spelling would have less difficulty in reading old books than one has now in reading Chaucer, for the simple reason that changes in spelling do not involve changes in the meanings of words. If necessary both types of spelling could be taught until most of the old books have been reprinted in the new spelling.

It is difficult to estimate the time lost in having to learn spelling. The equivalent of one school year does not seem to me to be too high an estimate. But however small the amount of time and energy lost by an individual may be, it becomes enormous when multiplied by the hundreds of millions who learn English in one generation, and by the uncounted number of future generations.

I fully appreciate the difficulty in deciding what is indispensable in a curriculum or in a text-book

[1] H. M. Dadourian, SCIENCE, 101: 611, 1945.

[2] Jacques Barzun, "Teacher in America." First e… Page 94. Boston: Little, Brown and Company, 1945.

I do not advocate, however, determining what is indispensable once and for all time, because this problem does not admit of such a unique solution. What I am suggesting is that educators, learned societies and text-book writers be aware of this problem and deliberately attempt to give it progressively better solutions in the light of experience.

The question "What is a dead language?" is not relevant to my suggestions and was not raised in my note.

In advocating the elimination of some topics from text-books, I have not lost sight of the student who does not intend to major in science. The examples I have given indicate that these students could dispense with the kind of topics I have in mind even more profitably than students who are to become specialists in science.

In advocating the teaching of science continuously through primary and secondary schools, I did not intimate that other subjects can not be taught so as to produce the desired results; neither did I refer to augmenting "the insight of the teacher." I claimed, first, that sciences are better adapted than some other subjects to stimulating the interest and maintaining the curiosity of the pupil and, secondly, that continuous and longer exposure to science is necessary for imparting the scientific outlook and for making science more palatable to college students.

In stating ". . . science is now taught in at least nine years of the twelve-year curriculum offered by most present-day public schools," the writers either include mathematics or use the word "taught" to mean "offered"; otherwise it would not be true. I should, perhaps, have stated explicitly that by "science" I meant the physical and biological sciences and by "teaching" I meant teaching as required subjects. These meanings of the words are clearly indicated by the context of my note.

I have before me a copy of the program of studies at the Hartford Public High Schools which are considered some of the best in the country. In this program the required and elective subjects are tabulated for each year and for each of the curricula designed for pupils who follow the courses preparatory to "Liberal Arts College," "Scientific College," "General Education," "Commercial," "Prevocational" and "General Industrial." Not a single subject in the physical and biological sciences is required in any of these courses, not even in the one preparatory to "Scientific College." So far as requirements are concerned, therefore, pupils could, and many of them do, graduate from Hartford high schools without having a single course in science. As to the Hartford primary schools, I am told that even the offering of a science subject is purely a matter of the discretion of the teacher and her enthusiasm for science.

The warning against producing "single track experts and the scientific ignoramus" is the old cry of "wolf, wolf" usually sounded by "liberal" educationists who ignore the fact that science has become the major source of new ideas and that the few scientifically trained men and women have done more than all the rest of mankind, during the past three hundred years, in liberating the human race from the fear of want and pain and in broadening our outlook.

To do full justice to the last paragraph of the communication of Professor and Mrs. Craft, one would have to write a book or at least a pamphlet, because it represents the epitome of a great deal of the material of articles and books on education written by "humanists" and "liberal" educationists. In these writings a single-track expert or an ignoramus is, almost invariably, a scientist. One might take the position that this is as it should be and take a criticism of this type as a compliment to men of science. For, after all, an ignoramus among scientists should be very rare and striking, in view of the fact that they not only know something about science but also perforce become conversant with a great deal of the non-scientific fields of knowledge and experience through their formal education and by virtue of being members of non-scientific communities.

The quotation from Jaques Barzun, "What do they know of science who only science know," deserves special comment. If the word "science" in this quotation is replaced by the name of any other subject the validity of the statement would not be changed. Yet, for some strange reason, only science and scientists are made the butt of this type of criticism. I should like to know the name and address of the zoo where the *only*-science-know bird is kept.

H. M. Dadourian

SIR ISAAC NEWTON AND THE SENSITIVE RADIOMETER

In Science of March 9, I have read with interest Dr. C. G. Abbot's letter (pp. 244–245) describing how he was led to find a remedy for electrostatic disturbance of a sensitive radiometer by a recollection of Newton's famous proof that a uniform shell of matter exerts no gravitational force upon any body placed within it.

The corresponding theorem in electrostatics, namely, that no electric field exists within a hollow conducting spherical—or, as in Dr. Abbot's two-dimensional case—cylindrical shell is, of course, well known and in fact comprised in the more general theorem that no field—due to external charges—can exist within a hollow conductor of any shape whatsoever. The proof of this is usually given as a particular case of Green's Reciprocation Theorem (*vide,*

e.g., Smythe, "Static and Dynamic Electricity," p. 38).

Dr. Abbot's comparison of the electrical with the gravitational problem suggests an extension of Newton's purely geometrical proof for the latter to the electrical analogue. For a uniformly charged spherical electrical shell, Newton's proof, namely, to divide the surface of the shell by double cones with their vertex at the field-point obviously applies, *mutates mutandis,* since the law of force is in each case the same, namely, the inverse square and the effect of area is exactly cancelled by the effect of distance.

It is interesting to note, however, that in the case of a circular cylinder, if end-effects be ignored, the same method of proof is applicable when the aforesaid set of cones degenerate into a set of double planes cutting off long strips on the inner wall of the cylinder each of an area proportional to the distance from their line of intersection while the law of electric force now becomes that of the inverse distance, so that complete cancellation again results.

Newton's theorem that the force exerted by a gravitating shell or sphere at an external point acts as if the whole mass were concentrated at the center is also transferable to the electrical case and provable by the same simple geometrical construction, choosing now for the vertex of the cones or intersecting lines of the planes the point inverse to the external point.

I have not seen this method of proof applied to these simple problems.

A gravitational parallel to the more general electrical theorem which would correlate the density (per unit area) of fluid matter distributed over a shell of any form with the total curvature is a further obvious extension.

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SCIENTIFIC BOOKS

SURVEY TEXTS IN PHYSICAL SCIENCE

Man's Physical Universe. By ARTHUR TALBOT BAWDEN. xv + 832 pp. New York: The Macmillan Company. 1943. $4.00.

Physical Science. By WILLIAM F. EHRET, editor, LESLIE E. SPOCK, JR., WALTER A. SCHNEIDER, CAREL W. VAN DER MERWE and HOWARD E. WAHLERT. x + 639 pp. New York: The Macmillan Company. 1942. $3.90.

The Study of the Physical World. By NICHOLAS D. CHERONIS, JAMES B. PARSONS and CONRAD E. RONNEBERG. vii + 883 + xiv pp. Boston: Houghton Mifflin Company. 1942. $3.85.

SURVEY courses in the sciences began to appear in college curricula in the years before the war, and it is probable that their introduction is now being considered at many colleges where they were unknown before. For this reason, though none of the texts listed above is quite new, it still may not be too late for a review to be of interest.

In the well-established fields, in which texts have been written for a century or more, the author of a new one will hope to make useful innovations, but his opportunity will be somewhat circumscribed and the risk of going far astray will be similarly limited. The author of a text for a college survey course is guided by fewer landmarks, and this should be remembered in any criticism of his work. On the other hand, since his text may be expected itself to become a landmark in a field where there are not many, it is all the more important to suggest improvements where it appears they might be made.

These three texts cover, at somewhat different levels, the same subjects: astronomy, physics, chemistry, geology, meteorology and physical geography. The boundaries between these subjects are, by design, disregarded.

"Man's Physical Universe" is the most elementary of the three. Its author is the president of the Stockton Junior College in California, and the work was doubtless written for students in that and other junior colleges. It is entirely without mathematics and almost wholly descriptive rather than quantitative. This restriction is naturally a handicap in treating the more exact sciences. The clearest exposition, in my opinion, is that of geology and physical geography, and the least clear is that of physics.

Not all the difficulties result merely from the use of descriptive rather than mathematical terms. For example, the meaning of "centrifugal force" is changed twice in four successive paragraphs, from the d'Alembertian sense of mass times negative acceleration to the sense of Newtonian reaction and back again. (Is it not high time to discard this term, at least from beginners' books? Nothing in which authors can become so involved is likely to be of any help to students). In general, I should say that basic concepts, especially the more difficult ones of physics, are too often hurried over rather than given the patient explanation they need if they are to be understood. This may make things easier for the more superficial reader, but it must confuse the earnest student, especially if he has taken seriously the author's advice at the beginning of the book to insist on careful definitions.

The sequence of topics is, roughly speaking, that of the decreasing scale of phenomena, from astronomy to atomic and molecular structure. This is a generally logical development. Every sequence must have its drawbacks, and the disadvantage of this one is that

the conclusions in some of the subjects first treated depend on the principles or experimental methods of some of those following.

The book is crowded with scientific and technological facts. Most of them are interesting and many are presented with an appealing vividness. Those within the competence of this reviewer are remarkably accurate in view of the almost endless opportunity for error, though there are ambiguities here and there which could have been avoided by qualifying statements. Long before the reader comes to the end of the book, he will be struck with admiration for the industry and patience which must have been spent in gathering so much material. But by the time he completes 800 pages, I am afraid he will be appalled at the perseverance which would be needed to remember one half or one quarter of all these facts. He may wonder if a part of the author's labor would not better have been spent in weeding out some of them and making the rest more easily recollectible by connecting them with stronger threads of basic principle. To cite an extreme example, even in a book of 800 pages, is it worth so much as a line to say that there are seven longitudinal holes in a grain of smokeless gunpowder, especially when no mention is made of the sole possibly interesting fact that they are there to govern the rate of burning and the resulting development of pressure?

I raise this question because it seems to me to concern the central purpose of survey courses. It is claimed that they acquaint the student with the fundamentals of the sciences freed from the technicalities of the specialist. This ought not to mean skimping the enduring principles to make place for transient details of technology.

In spite of what seem to me its rather serious limitations as an introduction to science, the work has value as a handbook of useful information for young people coming of age in a highly technical culture, a sort of guide book, not to a country, but to a decade. They will learn something of their opportunities and responsibilities as farmers, householders, cooks, purchasers of consumer's goods, drivers of motor cars and airplanes, and generally as citizens of a much mechanized society. And this, clearly, as much as any other, was the author's purpose in writing the book. His method is didactic and the text is in places at least as much a tract as an exposition, but it is honest pamphleteering and its motives will commend themselves to most people of good will.

"Physical Science," by five of the faculty of scientific departments of New York University, is written for more mature students than the intended readers of "Man's Physical Universe." The treatment of the several sciences is at the introductory college level and is perhaps a little more difficult than that in some college texts, because it is somewhat more condensed. This book is shorter than the two others reviewed here by more than the number of pages show, since it has also fewer words to the page. Consequently many of the details found in "Man's Physical Universe" are missing from "Physical Science." This seems to me a clear gain, as I have already explained. "Physical Science" comes fairly close, I should suppose, to the ideal suggested some years ago by James Harvey Robinson, when he wrote:

> What a considerable and beneficent revolution would take place in teaching and writing if teacher and writer should confine himself, at least in addressing beginners or laymen, to telling only such facts as play so important a part in his own everyday thinking that he could recall them without looking them up! It is a good rule for a writer to assume that nothing in his favorite subject which fails to interest *him* vividly and persistently is likely to interest the outsider who reads his book.[1]

This omission of what will not be remembered is a negative virtue but a very desirable one and much too rare.

The emphasis of the book is on basic principles, and these are treated with little or no sacrifice in exactness as compared with most elementary texts in physics (to make the only reasonable comparison that I can make with any knowledge). The one serious exception, as it seems to me, was rendered inevitable by the sequence of topics chosen, some of the elements of electricity being introduced before the development of the mechanical concepts on which the electrical definitions depend. The advantage of having the electrical foundation of atomic and molecular theory available early, to facilitate the discussion of chemical reactions, is evident. There is doubtless some gain also in postponing mechanics, which is often a stumbling block to beginners. However, it would still seem to me preferable to have the student learn the fundamental concepts of mechanics before starting on electricity, which is difficult enough itself, even with the aid of a knowledge of mechanics.

As much of algebra and the rudiments of analytical geometry as the elementary treatment of physics demands is incorporated in the text itself. There is also a discussion of the relation of mathematics and formal logic to scientific reasoning, which is naturally elementary but is not superficial and is, in my opinion, one of the most successful pieces of exposition in the book.

I noted in reading a few minor historical corrections. Franklin introduced the terms "positive" and "negative" electricity, not, as stated, in accordance with the two-fluid theory but in opposing it with his own one-fluid theory. Ptolemy employed but did not invent the epicycle of ancient astronomy. Newton

[1] "The Humanizing of Knowledge," New York, 1924.

did not use the concept of energy nor, to split hairs, did Faraday "conclude" that the laws of electrolysis showed the atomic nature of electricity. (He saw the possibility of this conclusion but refrained from drawing it because of his doubts as to the reality of the atoms of matter). None of these mistakes is of any importance, but they are perhaps of some interest as showing how great reputations grow even greater by attracting to themselves some of the material of lesser ones.

"The Study of the Physical World," by three of the faculty of the Chicago City Colleges, will be discussed more briefly, not that it is less deserving of attention but that much can be said about it quickly in saying that in many respects it is intermediate between the two books just reviewed. Its use of mathematics is somewhat less than that in "Physical Science," and the treatment is more descriptive and hence, in the quantitative sciences, somewhat less exact. The economic and social consequences of discovery and invention are given more attention than in "Physical Science" without being stressed as strongly as in "Man's Physical Universe." In the relative emphasis given to general principles and illustrative facts, it is nearer to the former book, and the attempt is made throughout to have the facts really illustrate the principles. This purpose is aided by a clear and straightforward style of writing. Unfortunately in the attempt to make hard things easier, there are some over-simplifications and a good many errors, some of them rather serious. An example of over-simplification is in the treatment of atomic structure, in which the illustrations show the electronic orbits of the older quantum theory, and nothing in the text indicates that recent developments have required a different description. Probably the most serious errors are in the treatment of heat and kinetic theory. Here the energy of linear motion of the molecules of a gas is taken as the whole internal energy, which would mean that all gases have the same specific heats. A fallacious derivation of Carnot's theorem is based on the misconception that the second law of thermodynamics is a corollary of the first. The human body is described as an engine transforming heat to work, although it has no temperature difference which could maintain anything like its actual efficiency if this were true.

Although at first sight the sequence of topics in this book appears rather haphazard, reading through the text shows, on the contrary, that it is quite careful. There are few places in which reference needs to be made to anything ahead, an achievement which must have given the authors as much trouble as it saves the reader.

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ORGANIC CHEMISTRY

Textbook of Organic Chemistry. By E. WERTHEIM. Second edition. 867 pp., including 113 text figures, colored plates, portraits, industrial flow sheets, tables, etc. Philadelphia: The Blakiston Company. 1945. $4.00.

How well the first edition of this excellent text was received may be gathered from the fact that, since its appearance in May, 1939, eight reprintings have been necessary. This new edition, therefore, will be welcomed warmly by the many friends already won by its predecessor.

As the author states in his preface, the general plan of the book, its aims and objects, are essentially those set forth in the preface to the previous edition. Some rearrangement of subject-matter has been made, and new data and interpretations have been incorporated to bring the text up to date. These include new tables, charts, colored plates of molecular models, numerical problems and additional review questions.

Detailed descriptions of individual compounds have been replaced by group reactions, class properties, tables of all kinds, charts and summaries.

No more fitting frontispiece could have been selected for this work than the portrait of Emil Fischer which appears therein, for he was truly one of the outstanding builders of the science. The picture is an admirable likeness as the writer remembers him at the height of his career, when Fischer's great teacher, Adolf von Baeyer, used to say of him that he was a more brilliant organic chemist than the master under whom he had studied.

The book is heartily recommended, as a two-semester beginners' course, to meet the needs of students planning to major or specialize in organic chemistry, as well as for those who are taking chemical engineering, premedical or pharmaceutical courses.

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BOOKS RECEIVED

BRADFORD, F. KEITH and R. GLEN SPURLING. *The Intervertebral Disc.* Second edition. Illustrated. Pp. 192. Charles C Thomas. $4.00. 1945.

BROWN, EARLE B. *Optical Instruments.* Illustrated. Pp. xii + 567. Chemical Publishing Company, Inc. $10.00. 1945.

HOBBS, WILLIAM H. *Fortress Islands of the Pacific.* Illustrated. Pp. xiii + 186. J. W. Edwards. $2.50. 1945.

HORNEY, KAREN. *Our Inner Conflicts.* Pp. 250. W. W. Norton and Company. $3.00. 1945.

MCELVAIN, SAMUEL M. *The Characterization of Organic Compounds.* Pp. xi + 282. The Macmillan Company. $3.40. 1945.

SCHWARTZ, LOUIS H. *Your Eyes Have Told Me.* Illustrated. Pp. 208. E. P. Dutton & Company, Inc. $2.75. 1945.

WILLIAMS, HENRY L. *The Fundamentals of Radio.* Illustrated. Pp. xiii + 204. New Home Library. $0.69. 1945.